THE

ELECTRICAL REVIEW.

VOL. XXXIII. DECEMBER 15, 1893. No. 838

CONTENTS:

	PAGE
The Edinburgh Electric Lighting Proposal	631
Municipal Authorities and Consulting Engineers	632
On the Distortions of Fine Wires Conducting Rapidly Oscillating Discharges	634
Long Distance Transmission in California	634
The Utilisation of Town Refuse for Power Production (*concluded*)	635
The New System of Alternating Current and Transformer Distribution.—VI. (*illustrated*)	635
Reviews:—Keely and his Discoveries: Aerial Navigation ...	637
A Manual of Telephony	640
Direct Current Dynamos of very High Potential	641
Crompton-Brunton Alternator (*illustrated*)	642
Correspondence:—Mattei's Liquid Electricities	643
The City and South London Railway	643
Legal:—Strick *v.* Latimer Clark, Muirhead & Co.	644
Notes	645
Contracts Open and Closed	648
Business Notices	648
City Notes:—Medical Battery Company	650
General Electric Power and Traction Company	651
Dover Electricity Supply Company	652
The Exploration Company	652
Venezuela Telephone and Electrical Appliance Company...	652
Traffic Receipts	652
Share List of Electrical Companies	653
Blackening of Incandescent Lamp Bulbs...	654
Development in Electro-Therapeutics	654
An Interesting Installation (*illustrated*)	655
The Installation of the Great and Little Bolton Co-operative Society	656
New Patents	657
Abstracts of Published Specifications	657

THE
UNIVERSAL ELECTRICAL DIRECTORY
(J. A. BERLY'S).
ORDER AT ONCE

PRICE 4/- POST FREE.
The Leading Electrical Trades Directory and the Oldest Electrical Directory in the World.

FOR THE 1894 ISSUE.

PRICE 4/- POST FREE.
Fully Revised and Thoroughly Reliable.
Contains a larger amount of commercial Trade Matter than any other Electrical Directory.

H. ALABASTER, GATEHOUSE & CO.,
22, Paternoster Row, London, E.C.

THE ELECTRICAL REVIEW.

Published every FRIDAY, Price 4d.

The Oldest Weekly Electrical Paper. Established 1872.

TO BE OBTAINED BY ORDER FROM ANY NEWSAGENT IN TOWN OR COUNTRY.

OFFICE:—22, PATERNOSTER ROW, LONDON.

Telegraphic Address "AGENCY, LONDON." Code A B C. Telephone No. 517

ALL Letters should be addressed to the Proprietors, H. Alabaster, Gatehouse & Co.

ADVERTISEMENT RATES ON APPLICATION.

The "Electrical Review" is the recognised medium of the Electrical Trades.

SUBSCRIPTION RATES.—In *Great Britain*, Post Free, per Year, 19s. 6d. To all *Foreign Countries* (except those mentioned below), per Year, £1 1s. 6d. *Exceptions.*—Abyssinia, Aden, Borneo, Ceylon, India, Java, Labuan, Mozambique, Penang, Persia (*viâ* Brindisi), Philippine Islands, Singapore, Zanzibar, to which the rates are: per Year, £1 2s. 10d.

BINDING.—Subscribers' numbers bound, including case, for 2s. 6d. each volume.

CASES.—Cloth Cases for Binding can be had, price 2s. 6d. each.

READING CASES, to hold from One to Twenty-six Numbers until the Volume is complete for Binding, can now be had from the Publishers, Price 2s., or Free by Post (in Great Britain), 2s. 6d.

FOREIGN AGENTS.—*New York:* D. VAN NOSTRAND, 23, Murray Street. *Paris:* VEUVE J. BOYVEAU, 23, Rue de la Banque. *Berlin:* ASHER & Co., 5, Unter den Linden.

Cheques and Postal Orders (on Chief Office, London) to be made payable to Mr. H. ALABASTER, 22, Paternoster Row, E.C.

THE EDINBURGH ELECTRIC LIGHTING PROPOSAL.

THE scheme set forth in the report of Prof. Kennedy is of more than passing interest: in the first place it is much more comprehensive than most proposals have hitherto been. It is drawn up with an eye to minimum initial cost, and also to minimum working expenses. The placing of the generating station near a railway, or on a railway siding, so that the coal can be delivered without cartage, is mentioned as a feature of the scheme.

The scheme then refers to the supply to the North and South sides of Edinburgh, and after considering the advisability of putting down two separate stations, Prof. Kennedy recommends one station for the two districts. This station is to contain two sets of machinery, a low-pressure continuous current set, for the near-by distribution, and a high-pressure alternating current set for the distant distribution. The report admits that there are inconveniences in using two sets of machinery, and a mixed system has apparently been adopted with some reluctance.

The arguments in favour of a low pressure three-wire system for the northern district, and the reasons for preferring it to a high and low pressure alternating current system are clearly set forth, and it is also clearly shown why a high pressure alternating current system should be adopted for the southern district. But there are no arguments or reasons given to support the adoption of the mixed system, when the supply of both districts is to be from one station. If the supply were to be confined to the narrow limits of the northern district, then the arguments in favour of the three-wire system are quite applicable and satisfactory. But granted that alternating currents must be used for the supply of the districts outside the northern area, why should it not be adopted for the whole, thus obtaining the advantages of having only one class of machinery? What is there to gain in using a three-wire continuous current system in the northern district? We should have thought that the northern district could be supplied on an alternating low pressure three-wire or two-wire system, while the other parts of the city could be supplied from the same system, by means of step-up transformers. We certainly do not think it is either the cheapest or the best plan to use continuous current for one district, and alternating current for the others. With low pressure alternators there is absolute safety in the station, distant supplies and arc lamp circuits can all be run off the same switchboards. There is always the great flexibility of the alternating system in its favour, but this feature is not noticed in the report, although the ease with which pressures in any part of the system can be transformed is most valuable, and one which is likely to become more and more apparent in course of time. With the fixed pressures necessary on the continuous systems, future improvements in

various directions are effectually prevented. The recommendation to adopt this mixed system in Edinburgh is an admission of the very limited application of the continuous current system. The cost of the supply is to be 6d. per unit, a price which will prohibit the use of the supply for anything but lighting purposes. In that case the alternating is as good as the continuous current system. Storage is not to be employed to any extent worth speaking of. With regard to gas engine sub-stations, the report speaks favourably of the proposal so ably advocated by Mr. Brown, of Rosebank Works, Edinburgh. The price of corporation gas may have been prohibitive, but we believe it would have been possible to have adopted Dowson gas plants and kept a reserve of gas for the gas engines.

We do not agree with the proposal to adopt a mixed system, principally on the grounds that the extension of the continuous current part of it is very limited, while the extension of the alternating system is unlimited in comparison, and considering the fact that alternating current is to be employed outside a certain radius, everything argues in favour of its adoption for the whole scheme.

MUNICIPAL AUTHORITIES AND CONSULTING ENGINEERS.

THE advance that is being made in municipal electric lighting is very gratifying. Unfortunately, this progress has brought in its train sundry evils which are too often peeping out. It is not long since we mentioned some exceedingly curious and irregular proceedings at a large seaport town during the settlement of the electric lighting question.

This is by no means an isolated instance; it if were, there would be little cause of complaint. None know better than contracting engineers that open competition for electric light contracts is sufficiently rare to warrant some special eulogium. Tenders are more often than not settled before they are advertised, and too often most unfair methods are employed to influence the decisions of municipal authorities. Not only this, there has been on several occasions direct evidence which unmistakably points to collusion between contractors, consultants, and town councillors.

A note in our last issue on the electric light at Coventry shows that, among other firms, Messrs. Hammond, with John Fowler & Co., had tendered for the lighting of the Borough, and had been entrusted with the contract. The following extraordinary, and, at first sight, inexplicable paragraph appears in the Light Committee's report:—"Your committee has received an offer from Mr. Robert Hammond, who is associated with Messrs. Fowler *in this matter*, to retire from the contract in order to act as consulting engineer to the Corporation for the execution of these works at a commission of 5 per cent., the contract being placed with Messrs. John Fowler & Co. (Leeds), Limited, at 5 per cent. less than the figure named in the tender. To this Messrs. John Fowler & Co. are ready to agree." The committee recommended that this arrangement be adopted. We are not going to comment upon the fact that Mr. Hammond announced some time ago that he was about to retire from contracting work, and devote his energies entirely to consulting work, nor that he publicly repeated this statement at Blackpool. One easily forgets little things, and in the bustle of a large practice, such a resolution might have been overlooked. But when Mr. Hammond performs a series of lightning changes during the consideration of an electric lighting question, we feel that his proceedings are distasteful and, we may add, scarcely decent. No doubt the Corporation of Coventry deem they have done well to secure the services of a consulting engineer with the abilities that Mr. Hammond possesses; but we are very much afraid that they are either ignorant of the duties of a consulting engineer, or that they suffer from a singular inappreciation to grasp Mr. Hammond's position. They saw that Mr. Hammond, after securing the contract, had offered to withdraw from the contract so that he might offer his services as consulting engineer at 5 per cent. on the contract price, and they saw that John Fowler and Sons, his partners in the contract, had considerately agreed to take 5 per cent. off their tender; the sum total to them was that they were obtaining a consulting engineer and electric light machinery for the same price. The most generous construction to put on the action of the Town Council is they imagined that when Mr. Hammond withdrew from contracting, he ceased absolutely to have an interest in a contract. Presumably they were not aware of the close connection between Mr. Hammond and Messrs. Fowler; the very fact that Messrs. Fowler were willing to submit to a reduction of 5 per cent. ought at least to have been taken as a strong bond of attachment. At any rate, it would be difficult to imagine any independent firm submitting to a deduction from their contract price for the purpose of providing a consultant's fee. To those outside the Council the matter has a clearer, or, shall we say, a darker aspect. There is only one interpretation. The chief duties of Mr. Hammond at Coventry will be to act as critic and to supervise the plant and materials and workmanship of a firm with which he is intimately connected. Is it to be expected that he can exercise an unbiassed judgment under such circumstances? It would seem that Messrs. Fowler, by their offer, acknowledge that his action has a money value to them of 5 per cent. We are not going to say that Mr. Hammond, in his capacity as consulting engineer, *will* lead the Corporation of Coventry to needless expense with his own firm; we can judge men only by their deeds. The position is a most invidious one, and it is to be hoped that consulting engineers who would accept such a position are rare.

The Employment of Electric Lighting Currents for Medical Purposes.

THE *British Medical Journal* of November 25th, contains an article on this subject by Dr. H. Lewis Jones, wherein the writer shows a laudable desire to encourage medical men to use these currents, and indicates how, in his opinion, this may be most conveniently done. As far as alternating current is concerned he agrees with the opinions expressed by Dr. W. S. Hedley when writing on this subject nearly two years ago,* viz.: that alternating currents may be safely and conveniently used from a 100-volt circuit by means of a suitably constructed transformer. In the matter of continuous current, however, his conclusions differ from those arrived at by the earlier investigator, for he discounts the use of resistances and recommends batteries of accumulators. If

* *Lancet*, December 19th, 1891, and April 9th, 1892.

electric light currents can be safely and conveniently used by the round-about and to the busy medical practitioner, troublesome process of charging and discharging accumulators only, we fear their chances of coming into general medical use are few indeed, and that primary batteries will easily hold their own. Dr. Jones trips lightly over the difficulties of the management of accumulators, and we can quite understand how, to the expert having at his command the resources of the electrical department of a large hospital, such difficulties may appear slight; but we very much doubt if the ordinary medical man, whose knowledge, experience, and resources in things electrical are necessarily very limited, could be induced to take the same view. The article concludes with a statement which is open to much question, and which, we fear, may tend to engender a false feeling of security in the minds of some of its readers. Enthusiasm is a good thing in its way, and an ardent electro-therapist may be forgiven much, but surely it is scarcely wise for one occupying so prominent a position in the electro-therapeutic world as the physician in charge of the electrical department at St. Bartholomew's to minimise risks of harm to patients, or it may be, of actual danger to life. He says that the dangers to be feared in the use of electric light currents, beyond those arising from carelessness on the part of the operator, are very small indeed, and goes on to emphasise this as follows: "With an 8-C.P. lamp permanently fixed in the circuit with the patient, his body cannot become the path of a current of really dangerous magnitude." If this be true, even taking the R of the body at 1,000 ω (and it is often less *under treatment conditions*), 70 to 80 m.a. may be regarded as a safe current to pass through any part of the body. That this is far from being the case is easily seen by the references to dosage in standard electro-medical works where a fourth of this quantity is sometimes spoken of as excessive. Doubtless, there are some forms of treatment where such a current is not only safe but advisable. The question, however, concerns all possible ordinary means of treatment, and that Dr. Jones's brother experts do not regard his view as a safe one is shown by a letter from Dr. W. S. Hedley in the *Lancet* of the 2nd inst. We have before now expressed our belief that light circuit continuous currents may be used safely and conveniently, *when properly protected*, and we still believe so; but we do not think that safety lies in a light regard of the possible dangers, however remote they may be. If all medical men were also electricians, an 8-C.P. lamp might, perhaps, be sufficient protection; but what we wish to point out is that in unskilled hands such an arrangement affords little or no protection, whilst the possibilities behind it form a danger far greater than the article quoted would lead its readers to suppose.

Alternating Currents of Rectangular Wave Type.

MR. KENNELLY has been investigating the current strength in simple circuits, in which the impressed E.M.F. is of a rectangular wave type, that is to say, where a constant source of E.M.F. is periodically reversed. His last results for circuits containing self-inductance in series with capacity are published in the *Electrical World*, of New York, November 11th. These results are expressed in terms of hyperbolic tangents, which is in many cases a more convenient mode of expression than using the original exponentials. It is rather a pity that Mr. Kennelly does not give the working out of his results, instead of quoting the final formulæ, as it gives his readers the trouble of working them out for themselves, or else taking his formulæ in faith, and as there is a bad misprint in the first one given, this latter plan can hardly be recommended. There are a series of curves plotted from his formulæ given, and from these it is shown that it is not possible to entirely neutralise self-inductance by a suitable capacity, as can be done in the case of sinusoidal waves, but partial compensation can, however, be effected by a suitably chosen capacity. Mr. Kennelly mentions at the end of his paper, "that the current strengths seem to have been hitherto algebraically determined solely by the use of infinite convergent series." He does not mention that these series are readily summed, they are in fact geometrical progressions, and comparatively simple exponential formulæ are obtained. In the case of no capacity the virtual current (square root of mean square)

$$= \frac{E}{R}\sqrt{1 - \frac{2}{x}\cdot\frac{1-e^{-x}}{1+e^{-x}}} = \frac{E}{R}\sqrt{1 - \frac{\tanh\frac{x}{2}}{\frac{x}{2}}}$$

Where x equals the half period (*i.e.*, time elapsing between two reversals of the E.M.F.) divided by $\frac{L}{R}$ or the time constant of the circuit. The latter form is the one given by Mr. Kennelly, only it is misprinted as

$$\frac{E}{R}\sqrt{\frac{\tanh\frac{x}{2}}{1-\frac{x}{2}}}.$$

Liquid Insulators and their Power of Insulation.

A SIMPLE method of investigating qualitatively the conducting power of dielectric liquids has been devised recently by Herr K. R. Koch. The apparatus which he uses consists of a modification of the "Dewar" capillary electrometer, described in *Nature*, Vol. XV., p. 210, in which a drop of the liquid to be examined takes the place of the drop of dilute sulphuric acid used in the ordinary way for determining differences of potential. This modified electrometer may thus be made so sensitive that the existence of polarisation, and hence of electrolytic conductivity, may be demonstrated with facility. The drop of liquid should not exceed 0·5 mm. in length. Any polarisation is indicated by a movement of the drop, the polarisation being in the direction (so far as Koch's experiments show) of an increasing surface tension at the cathode. By means of this apparatus, which is fully described in Wiedemann's *Annalen der Physik und Chemie*, 1893, No. 11, pp. 482—484, Koch has carried out a series of experiments in the Physical and Technical Institute at Stuttgart, on such dielectric liquids as benzole. This substance appears, when quite pure, to be a perfect insulator for electricity, and the conductivity which has been observed in commercial specimens depends upon the presence of impurities, especially water. Koch's method is sufficiently sensitive, and is probably superior to others that are in use, inasmuch as those methods of determining the dielectric constants of dielectric liquids, the result of which is influenced by a possible conductivity of the liquid, must lead to wrong results, for, since comparatively large amounts and surfaces of liquid are involved (instead of a drop 0·5 mm. in length), it must be almost impossible to keep out such impurities as dust and moisture.

Atmospheric Electricity.

AMONGST the meteorological observations which are now regularly carried on at the observatory on Ben Nevis, those which deal with the electrical phenomena of the atmosphere have already shown good results. For example, ample confirmation has been afforded of Prof. C. Michie Smith's theory that the potential is below the normal on the edge of a dissolving mist, but above the normal on the edge of a condensing mist. The observers stationed on the mountain have invariably noticed that when the summit becomes clear a strong current comes up the telegraph cable, while, as soon as it is again enveloped in mist, the current is reversed. During a fall of rain or snow a current nearly always passes down the cable, and in the case of a sudden shower, the spot of light reflected from the galvanometer mirror is sometimes driven violently off the scale. A cessation of rain or snow, on the other hand, generally has an exactly opposite effect. Admitting the assumption that the summit of Ben Nevis takes the potential of the vapour which covers it, and considering the earth-plate at the base of the mountain at zero potential, these results appear to confirm Prof. Smith's theory, a conclusive proof of which would be of great importance in the investigation of thunderstorms. Amongst other interesting observations it has been noticed that cases of St. Elmo's fire frequently appear in the winter months. A careful consideration of these cases shows that the weather which precedes, accompanies, and follows the phenomenon, always has marked characteristics.

ON THE DISTORTIONS OF FINE WIRES CONDUCTING RAPIDLY OSCILLATING DISCHARGES.

BY A. E. KENNELLY.

IN the ELECTRICAL REVIEW of September 8th, Dr. Bleekrode describes some interesting phenomena, first noticed, it would seem, by Becquerel in 1837, produced by rapidly oscillating discharges through fine platinum wires, the wires becoming bent and permanently contorted in small waves or serrations.

The following experiments were made to investigate the phenomena:—

An induction coil excited by an alternator, was arranged to produce at will spark discharges through a circuit possessing capacity and non-ferric inductance of such values as to set up a calculated frequency of roughly 500,000 ~, and fine metallic wires from 5 to 50 cms. in length were included between clamps in this circuit.

When discharges of suitable intensity were allowed to pass through the circuit, distortions were produced in the wire, as described and illustrated in Dr. Bleekrode's paper. The bends in the wire did not appear to follow any law of gradation or spacing, and were not confined to any plane or apparent definite succession of planes. Neither could the plane in which the bends occurred be controlled by a magnetic field of about 1,000 C.G.S. units of flux density. The distortion did not appear to depend upon the length of wire under trial, nor on its form, looped or straight. Feeble discharges would frequently produce numerous small wavy bends in the wire, but the largest and most abrupt distortions were usually established by more powerful discharges that brought the wire to a red or white heat. The results were obtained with fine wires of platinum, platinum-iridium, copper, silver, and german-silver, but in all cases rapidly diminished with the diameter of the wire. By passing the discharges through two parallel wires in contact, these became fused together, but remained separate at sharp bends so as to form a delta, showing that the distortion preceded the interfusion. The medium surrounding the wire did not seem to influence the effects which were produced in wires supported in air, water, oil, or highly exhausted glass tubes. The effect was not destroyed when the wire was hammered out into a thin flat strip. The best results were obtained with wires of platinum alloyed with 10 per cent. of iridium, having a diameter of 0·008 cm., and a resistivity of about 27,800 C.G.S. units at 20° C. Some bends were so abrupt as to contain an angle of more than 90°.

Microscopic examination of the more prominent bends with a linear magnifying power of 80, frequently revealed holes or craters in the surface of the wire at the bend, sometimes at the concave, at other times on the convex, side. Further examination showed that at numerous smaller bends similar minute craters or vent holes could be discerned. In a large proportion of the small bends no such external cavity could be detected in the cross section with the microscope, but as it was often difficult to cut the wire with sufficient precision, the fact that such sections frequently failed to reveal internal cavities, was not considered as a strong objection to the hypothesis that each bend in the wire was accompanied by a cavity at some point in the cross-section at that spot.

Experiments were next made with the same size of wire when heated with continuous currents. When the current was slowly increased to the fusing strength—1·4 ampères—the surface of the wire under the microscope showed numerous minute cracks or fissures, but bends or contortions if present at all, were very faint. When the fusing current, however, was applied suddenly, the bends and distortions were again occasionally produced, and these often revealed the same microscopic cavities either in the surface of the wire or on its cross section.

The above observations suggest the theory that the distortions in the wire are produced by the sudden expansion of minute quantities of gas occluded within the substance of the wire. If the crevice containing the gas happens to reside near the axis of the wire, the pressure developed by thermal effect of the current would probably be uniformly resisted by the walls of the chamber in the equatorial plane when viscously yielding at the fusing temperature, thus producing a local protuberance or enlargement of diameter, a condition frequently observed. As, however, the position of the gas chamber becomes more distant from the axis, the resistance of the side walls will relatively diminish on the side nearest the surface, so that the viscous yielding of the substance would no longer be uniform in the equatorial plane, causing distortion of the wire. So far as it has been possible to observe, the internal cavities have generally appeared upon the cross-section towards the convex side of the bend, as this supposition would require. When the increase of temperature is gradual, the occluded gas may frequently find an opportunity to escape slowly under its augmenting pressure, without distorting the walls of its chamber, but when a continuous current of fusing strength is suddenly applied, the rapidly increasing pressure acts upon walls that are already softened by heat, and might tend to set up a degree of mechanical distortion determined by the quantity of gas, its amount and rate of heat absorption, the geometrical conditions of its environment, and the elastic properties of the wire's substance during the period of heat application. If the gas chamber is near the surface, there may be an explosion of the outer wall, whose reactive momentum will be expended in bending back the already softened wire.

It is reasonable that the mechanical violence of these effects should reach a maximum with brief and rapidly oscillating high tension discharges.

It is also known that the quantity of gas occluded by an ordinary platinum wire, is such as to considerably diminish its capacity for long sustaining an incandescent temperature, unless that gas is aided in effecting its escape by prolonged annealing in vacuo.*

It can be shown that the difference in distribution of current density through the substance of a wire having the diameter and resistivity above considered is very small for frequencies of one million periods per second.

LONG DISTANCE TRANSMISSION IN CALIFORNIA.†

BY W. F. C. HASSON.

As a consulting engineer I represent a variety of companies in California who desire to transmit power electrically. The aggregate will amount to some 40,000 horse-power, the distance ranging from 10 to 40 miles. Notwithstanding the fact that Mr. Scott has referred to the successful transmission of power for lighting purposes at San Antonia for 28 miles, the transmission of power electrically for long distances in California is a failure. Over a year ago the first contract for a definite transmission of power was closed. I saw recently an unhappy superintendent of a mine in eastern Calfornia up in the mountains looking at his burnt-out field coils after this generator had been in operation for less than 13 days. Although this whole plant is very beautiful upon paper, although it is all logical, the mere fact of the establishment of a small plant for operation in an exposition such as we have here, and saying that all this may be done, does not establish the commercial success of long-distance transmission of power. The points that are necessary in this machinery are first, that it shall from its inception and from its installation operate successfully; the second, that it shall continue to operate. The machinery must be so built that it will run not only a day or an hour, but for weeks and months. It must be borne in mind that where this power transmission is necessary is almost invariably in countries where they are distant from railways, where repairs are impossible, and the machinery must be of such a nature, not only in its simplicity of construction, but in its lasting qualities, that accidents will be almost impossible.

I believe in the transmission of power. I have been the apostle of it for a year in California, but I must definitely establish the fact that as far as California is concerned, as

* *Vide* a paper "On the Phenomena of Heating Conductors by Electric Currents in Vacuo." *Proceedings* of the American Association for the Advancement of Science, 1879, page 173.

† Address before Section C, World's Electrical Congress, Chicago, August 24th, 1893.

far as the investors—the men who will make a success of long distance transmission in California—are concerned, the successful machine, for long distance transmission of power electrically, exists only apparently in some special machine, in the minds of the inventors and the promoters, or in some beautiful advertisement.

Four or five months ago I was called upon to decide upon certain plans for the transmission of 3,000 horse-power about 20 miles. Most elaborate, most beautiful detailed descriptions of the methods employed in arriving at the desired results were put before me, but not a single working drawing of any kind was presented by any of the three companies that were competing for this installation. It must be recognised that these experiments are so extensive that they can only be carried out by companies.

THE UTILISATION OF TOWN REFUSE FOR POWER PRODUCTION.

By THOMAS TOMLINSON, B.E., Assoc.M.Inst.C.E.

(*Concluded from page* 388.)

IT was shown in a previous article (ELECTRICAL REVIEW, August 11th) that the refuse of a town will not alone supply the amount of light likely to be required by that town, if even the best recorded performances of destructors (under sanitary conditions) be taken as a basis.

From conversations I have had with electrical engineers and from articles which have appeared in the technical journals, there seems to be an impression that the thermal storage system of Mr. Druitt Halpin has materially improved the value of destructors in connection with electric lighting.

Apparently this should be so. Here is a means of storage, economical in first cost and fairly efficient, which will enable us to change the power available from the waste heat of destructors from being a power of small amount available throughout the 24 hours to a power available at what rate we choose, the latter being the form in which power must be available to follow an electrical output curve: if the refuse alone could supply the total power required, and it were merely a question of regulating it, thermal storage would no doubt make the waste heat of destructors universally available; but this, as has been already shown, is certainly not the case.

The power available from the waste heat of destructors in a given district is comparable to that of a waterfall on a stream situated somewhere in the district; all that thermal storage can possibly do for it is accurately comparable to the provision of a shallow reservoir (with a 20 per cent. leak), into which the same stream shall continually discharge.

The value of such a power, in connection with an electric lighting scheme, must obviously be estimated by duly weighing—

1. The total power so made available.
2. The total power required.
3. The extra loss, if any, involved in the distribution of the whole power required from the destructor station instead of from the most suitable available site, from a purely electrical point of view; or, alternatively, the interest on the extra capital cost of keeping the loss the same.
4. Difference in value of sites.
5. Obvious local considerations, such as the value of condensation where the destructors are at the sewage outfall.

So we are, as might be expected, brought back to the consideration of the facts of each particular case, unless it can be shown that the power available from the refuse of a given population bears such a large proportion to the total power required to light that population, that the loss under 3 cannot possibly equal the gain under 1. This will be found to introduce at once into the calculation the system of electrical distribution which is to be adopted.

We can approximate near enough, for our present purpose, to the factors involved in 1 and 3, to gain some idea of how the matter really stands. Take a population of 20,000, the ashbin refuse collected per annum will be about 4,000 tons per annum, and the evaporative value from 500 to 800 lbs. of water per ton of refuse (using figures already deduced), that is to say, the actual power available from the ashbin refuse of a population of 20,000 is equivalent to the potential power of from 100 to 140 tons of coal; the demand of that population of 20,000 for light, on the usual assumption of 1·8 C.P. for 500 hours per head of population per annum, will involve the delivery of 300,000 units per annum at the consumers' terminals, requiring in coal from 10 to 20 lbs. per unit delivered, according to the system of electrical distribution, or 1,300 to 2,600 tons of coal per annum, 1,300 tons representing the consumption with a direct current low tension system without excessive storage; about 1,600 tons, the consumption with a high tension system, direct or alternate current, with sub-stations; and 2,600 tons, the consumption with a high tension system alternate current, without sub-stations. Certain obvious deductions may be drawn from these general figures—(1) the proportion of the coal equivalent of the waste heat of the ashbin refuse of a given district, compared to the coal required for the lighting of the district, is not large. (2) The proportion is yet large enough to warrant the belief that in many cases it may pay to utilise the power as auxiliary. (3) The proportion will increase both with any improvement in destructors, which increases their yield in power, and with any electrical improvements which increase the light obtainable from a given coal consumption. (4) The proportion is greatest in that system (the low tension direct current) in which the position of the central station will least bear shifting to any arbitrary site, and least in that in which the position of the central station may, without serious loss, be widely shifted.

In further support of the contention that thermal storage has not in any way changed the factors of the problem of refuse utilisation, it may be pointed out that thermal storage is not merely applicable to the utilisation of the waste heat of destructors (in fact, owing in most cases to the low temperature of the waste gases, it is not particularly applicable to this at all), but to the reduction of the coal consumption of electric lighting stations generally—a much wider field—so that an engineer, having decided that thermal storage is financially and mechanically sound, can use it equally well on the best available site, from an electrical point of view, or on the destructor site; clearly then the problem is, in general, to decide between two sites, which is precisely what it was before.

In fact, it cannot be too strongly insisted on that wide as is the promise of thermal storage in connection with electric lighting generally, it is not by any means the form of storage best calculated to render town refuse generally available in electric lighting, because it ties the central station down to a site in most cases unsuitable; the ideal storage in this connection would be as fuel, solid or gaseous, admitting of cheap conveyance and storage, and subject to small loss, and allowing the destructor station or stations, to be placed in the positions most suitable to them, and the electric light station in the position most suitable to it.

THE NEW SYSTEM OF ALTERNATING CURRENT AND TRANSFORMER DISTRIBUTION.

By RANKIN KENNEDY.

VI.

CONVERTERS FROM ALTERNATING TO CONTINUOUS CURRENT.

SINGLE-PHASE alternating currents can be converted into continuous currents only by one method now known, and that is by a combined alternating motor and a continuous current generator; this is the only plan at all worthy of consideration with single-phase. The "rectifiers" or commutators put forward for turning alternating into continuous current do nothing of the kind; they only convert the alternating into a pulsating or intermittent current. The author has seen all the commutator and rectifying devices brought out, and has actually tried the best of them on single-phase only to meet failure. With a deal of care and attention

a fairly useful intermittent current can be got by this means if the current is not large, say, up to 20 amperes; that is the best that can be said about the converting of single-phase into continuous current by rectifiers.

When we come to consider converters for two-phase currents we find several methods, all of them highly successful. It will be noticed that I use the term "converter" for an apparatus which is used to turn alternating into continuous current, in contradistinction to the term "transformer," the transformer is the apparatus for varying the electric pressures. In America, "converter" and "transformer" are used synonomously; that, however, is a mistake, and will in time die out.

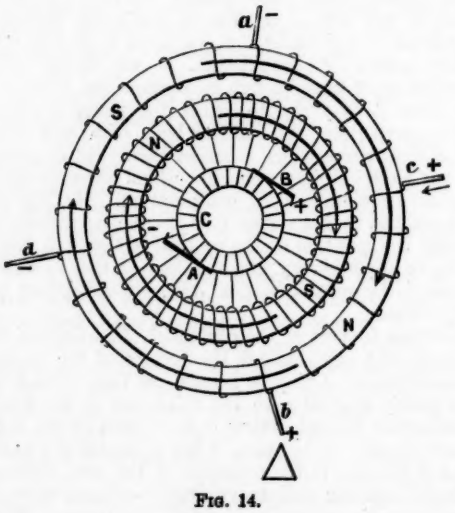


FIG. 14.

There is now another apparatus which performs the part of both a "converter" and "transformer;" that is, reduces the pressure, and turns alternating current into a continuous current in one apparatus; this apparatus, to distinguish it from the others, I call the "reproducer."

The transformers we have already referred to, and as they are now in ancient history, we may not pursue them further.

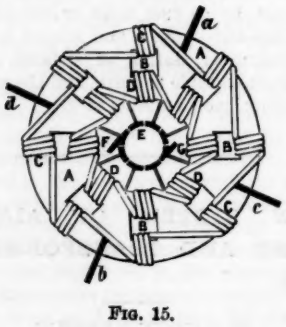


FIG. 15.

Converters and reproducers have, however, never before been described and explained, so that we must now take up the consideration of these; at the sub-stations on the new system reproducers are an absolute necessity.

Apollony and Messrs. Hutin and Le Blanc have devised reproducers on the principles illustrated in fig. 14, representing two concentric Gramme rings, in practice fitting close one within the other; the outer one is wound with fine wire all round, and connected at four points, *a*, *b*, *c*, *d*, to the two high pressure quadrature currents; the other ring is connected in the usual way with an ordinary commutator, on which revolves two brushes, A, B, driven synchronously by the alternating currents.

The two quadrature currents will now carry a pair of poles, N, S, round the outer ring, and induce a pair of reverse poles in the inner ring, thus generating continuous current in the inner ring, which currents are collected by the revolving brushes, A, B.

The pressures are in the ratio of the windings, same as in a transformer, so that if the outer ring has 100 times the number of turns of the inner ring, the continuous current collected will have $\frac{1}{100}$th of the pressure of the alternating currents.

This is a mere diagram; the actual construction is more like fig. 15, which is Apollony's construction for two-phase and fig. 16, the same inventor's, for three-phase. The primary

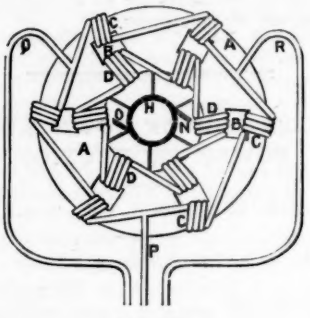


FIG. 16.

coils are wound on the outer periphery of a ring, built of iron stampings, passing through holes, B, and connected at four points, *a*, *b*, *c*, *d*, to the two high pressure quadrature mains. The inner coils, D, D, are wound on the inner periphery, and through the same holes, and are connected up to the Gramme commutator, E, around which revolves synchronously the brushes, F and G. The transformer and converter action will be, in these figures, seen very clearly.

These are exceedingly effective and economical reproducers, the only moving parts being the synchronising motors (not

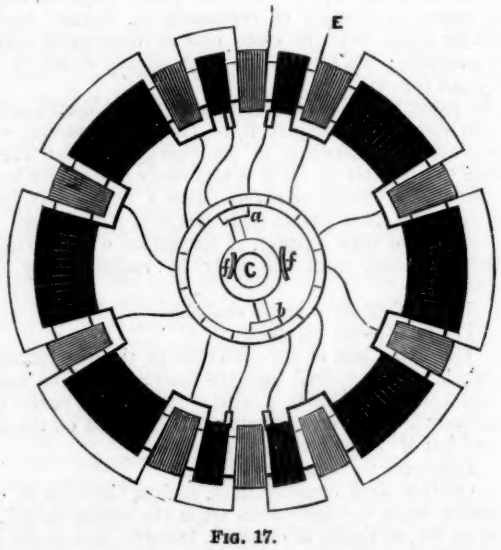


FIG. 17.

shown) and the brushes. Similar reproducers have been patented by Hutin and Leblanc, and the author made a similar one for two-phases two years ago, which worked successfully.

Another reproducer described in a most extraordinary specification, dated October 6th, 1892, by Messrs. Hutin and Leblanc, is likely to be very successful.

In this reproducer the primary and secondary coils are on one ring, forming one closed magnetic circuit, and there is a separate ring for each current; but the secondaries are joined all up to one commutator, and the sections of the one

secondary are coupled in series with the sections of the other secondary.

Referring to fig. 17, which shows one of the rings, the light shaded coils are the primaries all in series, and all same size. The secondaries are coupled up as a Gramme ring to the commutator, and brushes revolving synchronously collect the induced current in these secondaries. Considered as one ring energised by one current, the collected current would be a pulsating one; but two rings are used, as shown in fig. 18, which is a diagram of the apparatus, the rings being spread out straight, and only the secondary coils shown with their connection to the commutator.

These secondary coils vary in size according to a law which is laid down mathematically with great elaboration in the specification; but, in plain language, the big coils on one ring are coupled in series with the small coils on the other ring, as is clearly seen in fig. 18.

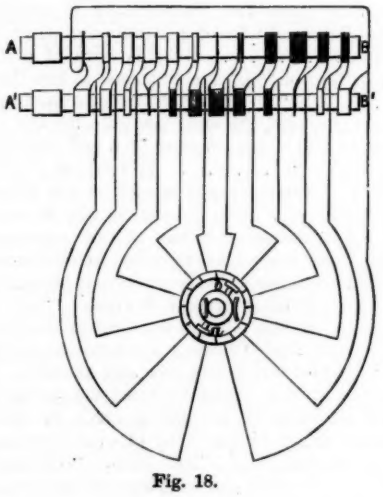


Fig. 18.

The coils are coupled up so that the induced E.M.Fs. oppose each other at the points in contact with the brushes at any moment, so that no currents flow, except in connection with the external circuit.

The revolving of the brushes keeps them on the two opposite points of maximum difference of potential on the commutator.

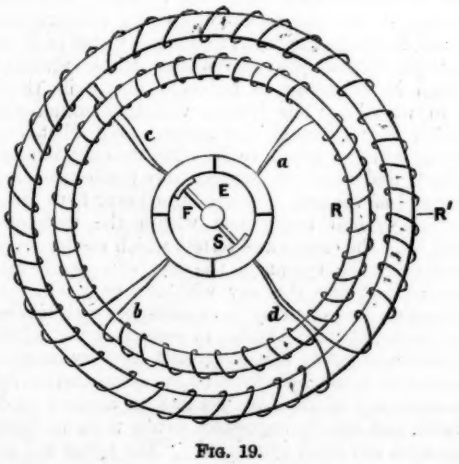


Fig. 19.

As the specification is not intelligible to ordinary mortals, and has some errors in the drawings, to make the principle clear let us suppose fig. 19 two rings, with only two coils of secondary on each, and a four-part commutator, all for simplicity. We show one ring within the other, although they may in practice be removed one to each side of the commutator, as they must not act on each other magnetically. The primary coil is not shown on either ring; in the position of the brushes shown they are in contact with the ends of the two secondaries of ring R¹, and as these are joined in opposition E.M.F., their combined current flows into the external circuit through the brushes; in this position the current in R¹ is at its maximum, while the current in ring R is at this moment at zero, as the current in R¹ begins to rise the current in ring R begins to fall, but the brush at the same time sweeps round, and at one point is connected with both rings, when both are about same value in E.M.F. Finally they reach a position at right angles to the one shown, and the current from ring R is now at a maximum, while R¹ is now at zero, and as the brushes revolve continually, it is obvious that a nearly steady current is thus obtained.

Now, if instead of having only two coils we have 12 coils on each ring, and make them differ in size according to their positions, and further, put them in series, the one secondary with the other, we will get a perfectly steady current.

This is an exceedingly elegant method, and one which seems very perfect. Up to 15 units the inventors find no sparking with a commutator of only 12 divisions.

These are methods for reproducing the high pressure quadrature currents as continuous low pressure currents. There are other methods, one at least equally as good, if not better, than any of these, but it cannot at present be published. The examples here given will be sufficient to indicate how easily two-phase currents can be reproduced as continuous currents. We now come to the consideration of the various methods of *converting* alternating into continuous currents on the two-phase system.

As in the single phase system, we can of course use the combined dynamo generator and alternating two-phase motor, and we can also use the quadrature generator of the type shown in fig. 10, and by sending in the two alternating currents at *a*, *b*, *c*, *d*, draw them again from the commutator at B, as continuous current.

These are quite practicable methods, the last one especially being a very beautiful method, the one machine with only one winding accomplishing the whole work of conversion.

The converter simply turns the two-phase alternating current into continuous current, and does not, like the reproducer, *transform*; it is, therefore, always used on a secondary circuit of the required pressure.

In places requiring continuous current for arc lighting, or for electro-chemical purposes, the converter would be placed to supply the required continuous current from the low pressure quadrature mains.

REVIEWS.

Keely and his Discoveries: Aerial Navigation. By Mrs. BLOOMFIELD MOORE. London: Kegan Paul, Trench, Trübner & Co., Limited, 1893.

One of the stories of "The Arabian Nights" is about a fisherman who had the luck to dredge up a sealed yellow-metal vase in his net. When the vase was opened it evolved a pillar of cloud which soon took the shape, and manifested the solidity, of a giant who possessed unlimited power. A clever Yankee has for more than 20 years been proclaiming that he has discovered that every molecule of matter is just such a sealed vase or minute oyster shell, each containing an enormous reservoir of mechanical energy.

We believe we are understating its magnitude when we say that he makes it to be at least the equivalent of a ton of the best Welsh steam coal per molecule. As there are more molecules in one rain-drop than inhabitants in the whole world, should this discovery be made good, we are not at all so dependent yet upon coal miners as we have lately been thinking we were. The only man who can open these molecular oyster shells, and eliminate those genii of force, has up till now kept this secret all to himself. He did, however, once bargain for one million sterling to let a thousand New Englanders into the secret, and the money was paid to his agents for the monopoly of this almightiness for a term of years. The shares in the stock of the company they started were floated up to 600 per cent. premium by

exhibitions of what he represented to be applications of this occult mechanical power. Alas, the price soon fell from that height to *nil*, which we understand is their present market value. The company brought him before a magistrate to enforce divulgement; he refused, and was committed to prison on a Saturday for contempt of Court. On the following Monday he was brought before a magistrate who pointed out to the plaintiffs that, as the contract to assign had not been stamped and filed in the patent office at Washington, they had no legal claim against John Worrell Keely. For their five million dollars the confiding Yankees got nothing but explanations in meaningless jargon from this professedly revolutionary discoverer.

"The thing that hath been, it is that which shall be; and that which is done is that which shall be done." Apparently in the belief that the same game can be played over again with equal success in England as in the United States, this volume, entitled "Keely and his Discoveries" on the outside, and "The Keely Mystery" on the inside, has been written by Mrs. Bloomfield Moore as the apologia of John Worrell Keely. The preface is by a reverend of Belfast. It begins thus—

"'Wait on the Lord.' When the Almighty is taking men into His deeper confidence as to His Creation ways, and how His ways may be taken advantage of for man's service and benefit, the gifted one through whom such revealing is being made should not be hurried by the common bustle of the world, but should be protected in the privacy where the Creator and he are closeted together in the giving and receiving which is thus transpiring."

We have painfully examined every statement in the volume before us, and the impression left is as if we had been compelled by duty to sit for a week in the company of a lunatic who raved incessantly in religious cant and doggrel science. Were this all, we should now put away the volume, merely in sadness; but we cannot shut out the conviction that there is method in the madness, and that the goal of it seems to be another million sterling, to be extracted before long from some of the great crowd of softheads amongst our countrymen, many of whom have recently been used as Harnessed asses to fetch treasure to Oxford Street. We will therefore examine the claims put forward by Mr. Keely, just as if they were honest statements based upon scientific knowledge.

The volume is so full of quotations from other authors, not written with any reference to "The Keely Mystery," and quite irrelevant in the sense of explaining or even defining these claims, that it is difficult to find even one sentence in the whole book which tells us what he claims to have discovered, or upon what proof he bases the claim. The people amongst whom we are placed may be divided into two lots, one, the Booths, whose creed is the Bible, the other, the Booles, whose creed is the multiplication table. Mrs. Bloomfield Moore appears to have set her lines principally to catch the Booths. Although the Creator and Prof. Dewar are being continually named for the Booths and the Booles respectively, we cannot see any connection between the professions of Keely and the Order of Nature, or that there has ever been any point of contact common to the Keely mystery and Prof. Dewar. It does not appear that Prof. Dewar has ever attended any lecture by Dr. Brinton at Mrs. Moore's, as we have done, or ever examined any of Keely's evidences. The only statement regarding Keely's claims made by Prof. Dewar appears to be that in 1884 he wrote: "If Mr. Keely succeeds in making his discovery practically useful, as it is said that he is demonstrating to scientists his ability to do—if this information be true, it is strange to contrast the past history of science with the present. Fancy the discoverer of electricity having succeeded in inventing the modern dynamo machine! Such a fact would mean the concentration of *hundreds* of years of scientific discovery and invention into the single life of one man. Such a result would be simply marvellous." To this statement we give emphatically our support.

The following passages taken from different parts of the book will give all the information we can find in it regarding Keely's quasi discoveries. "Molecular vibration is Keely's legitimate field of research." "The effects of the law of sympathetic association, which Mr. Keely demonstrates as the governing medium of the universe, find illustrations in inanimate nature. What else is the influence which one string of a lute has upon a string of another lute when a stroke upon it causes a proportionable motion and sound in the sympathising consort, which is distant from it, and not perceptibly touched. It has been found that, in a watchmaker's shop, the timepieces or clocks connected with the same wall or shelf have such a sympathetic effect in keeping time, that they stop those which beat in irregular time; and, if they are at rest, set those going which beat accurately." "Although physicists know that this extraordinary influence exists between inanimate objects as a class, they look upon the human organism as little more than a machine, taking small interest in researches which evince the dominion of mind over matter." "The only true medium which exists in nature is the sympathetic flow emanating from the normal human brain . . . . if metallic mediums are brought under the influence of this sympathetic flow they become organisms which carry the same influence with them that the human brain does over living physical positions . . . . and thus they become one and the same medium for sympathetic transmission." "The etheric flow. The true conditions for transmitting it sympathetically through a differential wire of platinum and silver have now been attained. . . . . By this wire of platinum and silver the current of force is now passed to run the vibratory disc . . . ." "In setting the conditions of sympathetic transmission by wire, the same law calls for the harmonious adjustment of the thirds, to produce a non-intermittent flow of sympathy." " . . . . Difficulties Keely has encountered in his persevering efforts to use the etheric flow in vibratory machinery. One by one he has conquered each, attaining the transmission of the etheric current, with this one notable difference—that, in order to show insulation to the sceptical, he passes the etheric current through blocks of glass in running his vibratory devices." "All forces are indestructible, immaterial, and homogeneous entities, having their origin and unity in one great intelligent personal will force." "Up to 1888 Keely was still pursuing the wrong line of research, still trying to construct an engine which could hold the ether in a rotating circle of etheric force; still ignorant of the impossibility of ever reaching commercial success on that line." Year 1888. "He now transmits vibrations along a wire, connected at one end with the vibratory machine which is the source of power, and at its other end with the engine or cannon, as the case may be, which is operated by such vibratory power. Until recently, comparatively speaking, Keely stored force, as he generated it, in a receiver. . . . . The confined vapour was passed through one of the small flexible tubes to a steel cylinder on another table . . . . full 25,000 lbs. to the square inch claimed. . . . . Keely diverted his etheric gas to the exciting work of firing a cannon, into which he placed a leaden bullet about an inch in diameter . . . . he gave a quick turn to the inlet valve, and a report like that of a small cannon followed, the ball passing through an inch board and flattening itself out to about 3 inches in diameter." "The vaporic power produced was so humid that he could not, when he attempted to utilise it, obtain its theoretical value in work." "The intense vibratory action which is induced in his 'Liberator' has accomplished what the retort of the chemist has failed to do, what the electric spark has left intact, and what the inconceivably fierce temperature of the sun and of volcanic fires has turned over to us unscathed. The mighty Geni imprisoned within the molecule, thus released from the chains and fetters which nature forged, has been for years the tyrant of the one who rashly intruded, without first paving the way with the gold which he has since been accused of using in experiments with reckless and wanton waste." "My system, in every part and detail, both in the development of this power and in every branch of its utilisation, is based and founded on sympathetic vibration. In no other way would it be possible to awaken or develop this force, and equally impossible would it be to operate my engine upon any other principle." "The power will be generated, my engines run, my cannon operated, through a wire." "Aerial navigation. The instrument devised by Mr. Keely for bringing the air-ship under control in its ascent and descent, consists of a row of bars, like the keys of a piano. . . . . These bars range from 0 to 100. At 50 Mr. Keely thinks the progress of the vessel ought to be about 500 miles an hour. At 100 gravity resumes its control. If pushed to that speed it would descend like a rifle ball to the earth. . . . . In the event of meeting a cyclone, the

course of the vessel, he teaches, can be guided so as to ascend above the cyclone by simply dampening a certain proportion of these vibratory bars." "The breaking up of cyclones will open a field for future research." "To the question, 'What does the supply cost in dollars and cents, per horse-power developed?' he answers, 'It costs nothing more, after the machinery is made, than the vibratory concordant impulse which associates it with the polar stream.' The twanging of a taut string, the agitation of a tuning fork, as associated with the resonating condition of the sympathetic transmitter, is all that is necessary to induce the connecting link, and to produce this 'costless motive power.' As long as the transmitter is in sympathy with the sympathetic current of the twin polar stream, the action of the sympathetic instrument or engine continues." "All molecular masses of metal represent in their interstitial molecular spaces incalculable amounts of latent force, which, if awakened and brought into intense vibratory action by the medium of sympathetic liberation, would result in thousands of billions more power in foot-pounds than that necessary to awaken it. . . . . If the latent force that exists in a pound of water could be sympathetically evolved or liberated up to the seventh subdivision or compound inter-etheric, and could be stored free of rotation, it would be, in my estimation, sufficient to run the power of the world for a century."

The reader must already have realised that these extracts are merely samples of lunacy, or something worse. If there had been no money in the speculation we should have tried to find an excuse for the man's perversion of reason, and the excuse we would have given may be, instead, the explanation of how it is that Keely has succeeded in making so many dupes. To get a table to stand it is necessary that it have at least one real leg, and so it is with lies, there must be some truth on which to base likelihood.

Keely may have at first, himself, believed in sympathetic vibrations, and afterwards he may have led on his dupes on the same line in which he had himself gone wrong. "Sympathy" means "suffering in common," and primarily it relates to mental suffering. Now we know that grief is often contagious, and sympathy may be excited in a great many minds without any diminution of the anguish of the original sufferer. The fallacy in Keely's system is, that he confounds this quality of mental sympathy with physical synchronism, which is only called sympathetic by a quaint poetic fancy. There is no more *sympathy* in induced vibrations in pendulums than there is in the movement of billiard balls, only the mediate causation is less obvious.

If one pendulum, a-swing, without mechanical driving power, by its vibration, starts motion in another pendulum, also without driving power, the amplitude of swing of the first pendulum is diminished as that of the second pendulum is enlarged, so that, if of equal weight, the sum of the squares of their amplitudes is never increased. Only careless illiterate observers would ever be misled, as Keely professes to be, when he asks in our second quotation, what else than the effects of the law of sympathetic association is the influence which one string of a lute has upon a string of another lute, in sympathising consort. It is that aspect of the principle of the conservation of energy, or the principle of work, which is known to electricians as the law of Lenz. How clear and beautiful is physical science, and how different in its language from Keely's explanation of the dynamic force which had been causing a small globe to rotate. "I cannot describe it other than the receptive concussion of the two forces, positive and negative, coming together, seeking their coincidents, and thus producing rotation by harmonic waves, not streams." Keely plays with the word "sympathetic," employing it in the sense of its mental quality, creativeness, when applying it to purely physical phenomena, in which the law of conservation of energy is rigidly absolutely true. It will be generous in us to suppose that Keely and his supporters are ignorant of this law, as applied to pendulums and other vibrating bodies, or, at least, that, at the outset, Keely believed simply that sympathy was sympathy wherever it was observed, whether in bulls buying stock at 600 premium, in the destruction of a suspension bridge under the march of soldiers, or in the undulatory propagation of light. Unfortunately for Keely's base of operations, the ether is absolutely indifferent to periodicity of vibration. Velocity of propagation is constant in the ether, but rapidity of vibration may be just whatever the exciter impresses upon it. It is the property of periodicity which makes a body cumulatively susceptible to vibratory influence, and this property is, in the ether, wholly absent.

There is another fact made use of by Keely, a fact true in Nature, but not generally known. To even educated men, ignorant of this fact, the suspension of more than, say, 32 inches of mercury by atmospheric pressure would appear as if the vacuum had been obtained by encroachment on the ether. See how Keely deals with it: "The very evolution on the negative shows a vacuum of a much higher order than was ever produced before, thus confounding, to perfect blindness, all theories that have been brought to bear upon the situation in its analysis. The highest vacuum known is 17,999,999—1,000,000 (*sic*) lbs., or not quite 30 inches; but by this process etheric vacuums have been repeatedly produced of 50 or 57 inches, ranging down to 30 inches or 57 lbs. (*sic*)." This is Keely's statement, and the slovenly numeration is worth observing. As he says, "ranging down" the 57 lbs. marked by us (*sic*) must be intended for something less than 57 inches. We are, therefore, dealing fairly with the statement in assuming that he only claims to have shown a column of mercury 57 inches high, suspended by atmospheric pressure against a vacuum rarefied by abstraction of ether. We were shown, at Mrs. Bloomfield Moore's, a solid brass ball and a glass vase, and told that Dr. Brinton had frequently seen that ball rise to the top when the vase was filled with water, when the slack wire attached to the ball was connected to a resonator, and a certain note sounded. We asked to see the experiment, and Mrs. Moore was quite astonished at the request. "Do you doubt the gentleman's word? He tells you he has seen it frequently." We did not see the column of mercury 57 inches high, but we advise any one who may be ever invited to witness it to remember the following explanation of such a phenomenon, given by Newton 176 years ago, Newton's Optics, Book III., Query 31. "The parts of all homogenal hard bodies, which fully touch one another, stick together strongly. . . . . And how such very hard particles, which are only laid together, and touch only in a few points, can stick together, and that so firmly as they do, without the assistance of something which causes them to be attracted or pressed towards one another, is very difficult to conceive. The same thing I infer also from the cohering of two polished marbles *in vacuo*. And from the standing of quicksilver in the barometer at the height of 50, 60, or 70 inches, or above, whenever it is well purged of air and carefully poured in so that its parts be everywhere contiguous both to one another and to the glass. The atmosphere by its weight presses the quicksilver into the glass, to the height of 29 or 30 inches, and some other agent raises it higher, not by pressure into the glass, but by making its parts stick to the glass, and to one another. For upon any discontinuation of parts made either by bubbles or by shaking the glass, the whole mercury falls down to the height of 29 or 30 inches." After Keely's ravings, it is refreshing to read such a paragraph as this, of Newton's. No man who has appreciated Newton's writings can ever be inveigled into believing for a moment any of the rubbish put together by Keely and Mrs. Bloomfield Moore.

No root has been more productive of perpetual-motionists than the form of crass ignorance which regards force, work and power, as synonymous terms; which confounds speed and rapidity, velocity and rate of acceleration, and measures volume in square inches. The book is written, all through, as if these were recognised equivalents in the convention of science. In the following quotation every one of these irrationalities is exhibited: "To move suddenly a square inch of air, at the velocity of this vibratory circuit, on full line of graduation, and at a vibration of only 2,750,000 per second, would require a force, at least, of 25 times that of gunpowder. . . . To induce an action on a weight of only 20 grains, the weight of a small bird shot, with a range of motion of but one inch, giving it an action of one million per second, would require the actual force of two and a half tons per second; or, in other words, ten horse-power per minute."

The "Conclusion" appears to be a lecture which we heard delivered on a Sunday afternoon at Mrs. Bloomfield Moore's, by a "Dr. Brinton," otherwise "Prof. Daniel G. Brinton, of Pennsylvania University." Having already applied the word "lunacy" in describing Keely's statements, we differentiate Doctor Brinton's production as idiotic quackery, or science

for idiots. "The evolution of what is called 'matter' from the different modes of vibration is through the action of the second law, that of focalisation, or 'negative attraction,' or 'negative affinity.'" We need not waste our time over such idiocy, but we sympathise with the parents of the youths who are entrusted to the guidance of such a professor at Pennsylvania University. Here is a sample of his arithmetical qualifications:—"for the molecular orders

1 : 3 : 9 : 27 : 81 : 243.

This arithmetical progression changes in the atomic orders to a geometrical progression, as follows:—

3 : 9 : 81 : 6,561 : 43,046,721, &c.

This same method of progression is believed to hold in all the orders of vibrations above the molecular, and soon passes into mathematical affinity." Our professor evidently does not know anything about either arithmetical or geometrical progression. We may tell him that the logarithms of these series of numbers are in arithmetical and geometrical progression respectively, but the word "logarithm" has not been seen by us in all the volume.

We have given in a quotation Keely's description of an air ship. According to what we were told by Dr. Brinton, and according to this volume, the ships for ocean navigation on Keely's plan will have no boilers, no engines, only a syren and a resonator, and a conducting wire between the hull and these instruments. A kind of violin would suffice on which the engineer on watch would have to keep bowing one string for going ahead and the other for going astern, and speed costs nothing.

Patient reader, we sincerely apologise to you for having dealt at great length with such an exhibition of profane alienation of human intellect as this volume by Mrs. Bloomfield Moore and J. Worrell Keely is.

A Manual of Telephony. By W. H. PREECE, F.R.S., and A. J. STUBBS. London: Whittaker & Co.

In 1888 was published "The Telephone," by Messrs. Preece and Maier, and in the ordinary course of events a second edition of that work should have been looked for, but instead of retaining the form of the original and bringing it up to date another collaborator has joined the Engineer-in-Chief of the Post Office, and they have produced a new work which epitomises the historical portion of "The Telephone," and the practical portion has, with the best results, been re-cast and re-written. The scope of the work has been concisely stated in the preface. If we may summarise a summary: Part I. deals with transmitters and receivers, theoretically, historically, and practically; Part II. is devoted to complete instruments or "sets," and "supplementary apparatus"; Part III. leads us to exchanges of a "simple" character; and Part IV. to the less simple multiple systems. "The scope of Part V. is of a rather less defined character, comprising chapters on subjects which are closely associated with exchange matters, together with some having a more general bearing," including military telephony, in which application an instrument capable of reproducing the refinements of articulate speech is, for apparently good and sufficient reasons, reduced to the reception of the vibrations of a "buzzer," termed by courtesy a "musical note," which being suitably interrupted conveys messages by the Morse code. Part VI. deals with line construction in some of its more theoretical and specially telephonic features.

A work on practical telephony is an excellent subject for critics. According to their individual "bent," its scope may be too wide or too narrow; it may omit something which should have been included, or include something which should have been omitted; or, if haply there be no serious omissions or unjustifiable inclusions, then no proportion may exist in the relative importance of the subjects treated. The critic who would follow such a plan with "A Manual of Telephony" must skip the preface or he will find himself disarmed: "In a work of this kind it is almost impossible to avoid occasionally giving undue notice to some matters of minor importance to the exclusion of others of more general interest. We (the authors) can only say that this consideration has been present with us step by step, and that we have striven to adopt the middle course throughout." The result is satisfactory. Those unfamiliar with the subject will find its history and progress briefly described, and obtain a very good idea of some of the difficulties connected with practical work. Those who are engaged in telephone business will find excellent descriptions of apparatus which they use and some which they do not. The descriptions are clear and the references precise. Many of the illustrations are new and good, but a special word of commendation is necessary for the diagrams. They are well designed, well drawn, and clearly printed. Some of them illustrate very elaborate circuits, but the arrangement is such as to preserve a balance without unduly deranging the natural position of the various parts, and preventing the intricacy which too often gives electrical diagrams the appearance of a maze constructed for the purpose of obstruction rather than to facilitate the finding of a way out.

The multiple system is well led up to, and the latest example—the branching and self-restoring drop system—described and illustrated.

In the final chapter it is explained that there are two K's—the effective and the calculated—and that it is the effective which must be calculated with. The other factor (R) in the well-known law has only one personality, but "mutual induction," has sometimes an important bearing in determining the limits of speech transmission. This chapter is not the least interesting and instructive, and it concludes the work with the statement "that there is no theoretical reason why speech should not be maintained between Europe and America," which we hope will not lead to too sanguine anticipations of a speedy service of trans-Atlantic conversation. For ourselves, we give due attention to that blessed word "theoretical," and await further researches in negatived retardation by Prof. Silvanus Thompson.

The authors' views on transmitters (p. 37) do not differ from those expressed in the orginal work (p. 40), that "the Edison form of transmitter has disappeared and in the same way as all magnetic telephones are more or less imitations or modifications of the original Bell instrument, so all carbon transmitters are now modifications of Hughes's ingenious apparatus." This statement is quite in accordance with the general opinion, but, in a future edition of the work, we hope that some slight modification may be made. It seems to us it would be fair to make a distinction between Hughes's discovery of the microphonic effect and the form of the apparatus devised for utilising it. We can also distinguish between the form of telephonic transmitter devised by Edison and his conception of the causes of its operation. Having made these distinctions we can question whether the Edison form of transmitter has disappeared, and for an answer we may appeal from the authors' words to the authors' work. Of the carbon transmitters illustrated, one-third may be classed as of the microphone form with the slightest modifications from Hughes's original instrument, and two-thirds as of the Edison form, with more or less divergence in details, but there is a striking resemblance in outline between the original Edison (fig. 8, p. 32), and the latest example—the "solid back" (fig. 64, p. 90), described as in use over the New York-Chicago line. It appears therefore that so far the arrangement of parts—or the "form"—of the best carbon transmitters is the Edison form. The diaphragm and the variable resistance are arranged as Edison arranged them, and are operated as he intended them to be operated. We cannot object to the definition of all carbon transmitters as microphones—the Edison was just as much a microphone as any of its later brethren, but its inventor did not know it, and hence the difference in results and the varying credit to be awarded. It seems to us the paragraph we have quoted is hardly just to Edison. All the imitations of Bell's are of later date than Bell's, but the Edison transmitter preceded the Hughes microphone, and, consequently, deserves more considerate treatment. Edison may be credited with devising a "form" which has survived without detracting in the least from the greater credit accorded to Hughes for the discovery of a principle which has enabled others to endow that "form" with a more subtle vitality.

From correspondence in our own columns towards the end of 1890, we are led to doubt the correctness of the remarks on single cord switchboards (p. 200). In other respects it seems to us that but little criticism can be offered on the practical features of the work. It is impossible to give an adequate outline of them, and we can only recommend our readers to study the work for themselves.

DIRECT CURRENT DYNAMOS OF VERY HIGH POTENTIAL.*

BY F. B. CROCKER.

THIS treatment of the subject is in no sense a formal paper, being merely a note of some experimental results which I have obtained from two dynamos with very high potential, and it is well, I think to define what I mean by that expression, which is in some doubt. By very high potential I mean from 5,000 to 11,000 volts. Machines of this character have received comparatively little attention, either from scientific experimenters or practical engineers. Considering these machines historically, the first fact that meets our attention is that there exists a general and deeply rooted idea that direct current dynamos of very high potential are not at all practical. This unfavourable opinion is particularly strong in regard to the use of such machines for the transmission of power for any considerable distance; in fact, such a system is considered to be almost out of the question. The actual historical and practical facts are that the high potential direct current machines were more extensively and successfully operated when the dynamo first came into general use about 1880 than any other type, either direct or alternate. Furthermore, their number and size have largely increased, and the voltage at which they can be practically worked has been steadily raised until we now have about 60-light arc dynamos of the standard size on large machines generating about 3,000 volts or 10 ampères. Arc dynamos of 90-light capacity are also regularly made, by several manufacturers, and 120 or even 125-light machines are built and used. I happen to know of one station where there are four arc dynamos rated at 125 lights, which run every night with a load of from 100 to 105 lights. These machines must have force to generate about 5,000 volts each. No great practical or other difficulty is found in operating arc machines, except that of danger to persons, but this is merely due to the high potential and does not depend very much upon the type of machine or character of current. Nevertheless, when it is suggested to use direct currents in the transmission of power, we are told that nothing over 1,000, or, at the most, 2,000 volts, is at all practical. Why this discrepancy between the 5,000 volts which are practically used in arc lighting and the 1,000 or 2,000 volts that are considered the limitation of such machines for power transmission? Perhaps the first answer to this question would be to say that the current is limited; that when you have 5,000 volts you cannot have more than 10 ampères, and if you want more ampères you must have less volts; consequently the number of watts, which, of course, is the entire question in power transmission, is limited. For example, the machines which I cited, and which are in practical and successful use, are 5,000 volts electromotive force, generate only 10 ampères, and consequently have a capacity of 50 kilowatts, which is a small power, comparatively speaking, for power transmission, but is sufficient for ordinary arc lighting circuits. That, of course, is a fairly good explanation of why such machines are not applicable to power transmission. But is there any such limit as 10 ampères to the current? I myself always look with very much suspicion and doubt upon any such arbitrary limit as that. Experience has shown me that those arbitrary limits are usually imaginary. Now, it is a fact, however, that should be added to this historical consideration of the subject, that numerous attempts have been made to employ such machines for power transmission and other purposes, and it cannot be said that those attempts have been successful; in fact, it can be said that they have been unsuccessful, but there, again, we have merely the negative of it. Now, when we come to the actual construction of such machines, and that is really the only substantial point that I can bring before you, I have actual results, although I cannot say that there is any particular feature of such machines which is radical or which will ensure their successful operation. The first point, of course, is insulation. That must be above suspicion. The ordinary limit of one megohm of insulation is simply nothing for such machines. One megohm of insulation resistance, with a voltage of 10,000, would give $\frac{1}{100}$th of an ampère and 100 watts; consequently the machine insulation would be rapidly heated up and destroyed; therefore you must realise that a megohm, or even several megohms, is no insulation at all for such a machine. It should be at least 1,000 megohms, which is number one, in fact. The next point is the commutator, because although the commutator might be considered the first point, as a matter of fact we must have the insulation before we can operate the machine at all, even for a few moments. The commutator, of course, must have a number of sections. It must have a considerable thickness of mica insulation between the bars, more than is ordinarily employed; I should say a full sixteenth of an inch. On the end of the commutator, where you get much more than the ordinary voltage between the bars, you require very much more thickness of mica insulation or some other insulation than is ordinarily given.

The next point is the material for brushes, and I have found in that particular feature the most peculiar and important differences. In the first place, I consider that it is impossible to run an ordinary mica insulated commutator with copper brushes at that potential, the reason being that this film of copper which is worn off of the copper brushes by the mica is a sufficiently good conductor at that electromotive force to carry many watts of current. At an electromotive force of, say, 500 volts, comparatively speaking, for instance, the ordinary railway generator, we have no such difficulty, because even if we use common brush connections the film of copper that is rubbed on to the surface of the mica would not carry sufficient watts to cause any trouble, but at 10,000 volts, with a total electromotive force in the neighbourhood of 100 volts between the bars, the amount of copper, even although it is an almost infinitesimal film, is sufficient to carry, as I say, many watts of current. Now, I have found that with a potential of only 5,000 volts, which I have experimented with, copper brushes could not be used for half a minute; that the copper would work off on the mica and immediately produce a ring of fire all around the commutator. Naturally one would use carbon brushes in such a case, because the current is very small, comparatively speaking, and there is no reason why we should not use carbon brushes. When you come down to the carbon brushes, I have also found that the hardened carbon is better, for the reason that it does not produce a deposit or layer of carbon on the commutator to produce the same effect which the copper does, but not to the same degree, because carbon is a much poorer conductor than copper; therefore carbon brushes, with a comparatively small area of contact and a fairly good pressure, not very great, but sufficient to insure good contact, seem to be the proper working conditions.

The machines I have actually constructed are two. One was a small machine of 1 horse-power capacity, and the armature was a fluted armature. Some persons may think that is exactly wrong, but the results do not seem to show that it was. It was very perfectly insulated with mica and wound with double silk-covered wire. The potential of that machine was intended to be 5,000, and I have succeeded, by slightly raising the speed, in getting 5,500 volts out of it. It had only 32 commutator bars. That machine is not, of course, a practical machine, but it did run for hours at 5,000 volts; for an hour and a-half at 5,500 volts, and several times without any difference.

The next machine, which is a much more practical machine, was of 5 horse-power capacity, and designed to generate 10,000 volts. It did generate 10,000 volts at a little below the calculated speed, strange to say, and gave 11,000 volts at about the speed it was designed for, which was 1,800. This machine had 108 commutator bars, a much more practical number for such a voltage. The current of that machine was intended to be between three and four-tenths ampère, which gives about its capacity. It must be remembered that these machines did not give their full capacity, owing to the fact that the wire is extremely small, and therefore the percentage of copper in the winding is small. The winding is largely made up of silk, consequently the capacity of the machine is reduced by that fact. That is inherent in any machine wound with extremely small wire. The current actually obtained from these machines is in the neighbourhood of their rated capacity. It would be unfair to myself and to you to deny the fact that there is a spark when you approach the current capacity of the machine, and I think at the current capacity the spark would be too great.

* Address before Section C, World's Electrical Congress, Chicago, August 24th, 1893.

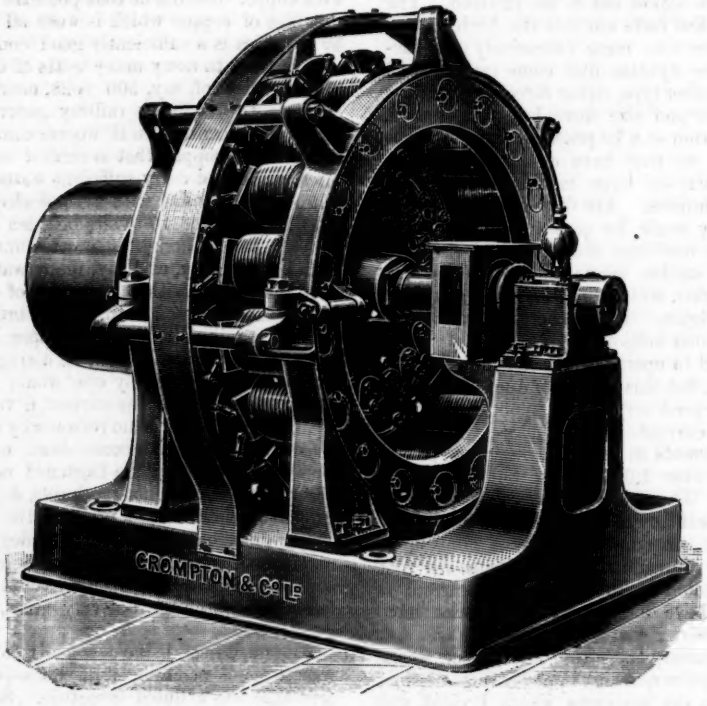
Now, as to the application of these machines, I would say that the purposes to which I have applied them have been ordinary experimental work. For example, one of these machines, at 3,000 or 4,000 volts, will run a Geissler tube very beautifully. It will produce any other of the so-called electrostatic effects, that is to say, effects produced by very high potential in small quantities. It will, for instance, act very much like an electrostatic machine or a friction machine. It will cause one of these electrical flyers to revolve. In other words, you can get all the electrostatic effects similar to this potential from an ordinary frictional machine.

. Another purpose to which the machine is applicable is testing of insulation, and in fact, that is one purpose for which I made it. It is a very good way to test insulation. You will immediately ask, why not use a high potential transformer, as being more convenient, and not having a commutator? I answer that by saying that I do not think that is the same test. If the wire is exposed to a direct current strain, I do not think an alternating current test is proper. If a wire is subjected to a direct current strain, it should be subjected to a direct current test. If it is subjected to an alternating current strain, it should be subjected to an alternating current test. The other application is, of course, power transmission, and that will be discussed hereafter, and I would say that, of course, it is not necessary to have the total voltage generated by one machine. In any plant no one dynamo should constitute more than a comparatively small fraction of the total plant, and if you have five dynamos in a central station, or power-transmission station, there is no reason why they should not be connected in series as well as in parallel, and if you want five machines, as I think you do, in order to guard against the trouble from break-downs—five to ten machines—then you can easily connect them in series, and subdivide the voltage just to that extent. Each machine can generate a few thousand volts, two to five, and you could get the total voltage by the proper series connections of several machines.

Electric Lighting of Wellington, N.Z.—Some weeks ago the plant of the New Zealand Electrical Syndicate was tested at Wellington. At the station there are five dynamos, each capable of supplying electricity for 2,000 incandescent lamps of 8 candle-power. The total expenditure of the syndicate, up to the present, has been fully £30,000.

CROMPTON-BRUNTON ALTERNATOR.

MESSRS. CROMPTON & CO. have for some time past occupied themselves in working out a complete system of alternate current machinery, and they believe that they have, while proceeding on well-tried lines, by a careful attention to proportions and mechanical details, succeeded in turning out designs which will, in practice, prove thoroughly reliable and extremely efficient. The most important item of such a system is, of course, the alternator, and we illustrate below a 60-kilowatt machine. These alternators have revolving armatures and stationary field magnets. The present is scarcely the place in which to detail at length the reasons which have led Messrs. Crompton & Co. to adopt this design in preference to that using a stationary armature and revolving field magnets, and it will be sufficient to say that their choice has only been made after careful consideration and considerable experience with both types. Special attention has been paid in this machine to the following points:—1. A ready access to the armature for inspection or repair by opening one or both upper halves of the field magnets, which are hinged for that purpose (see fig.). 2. Facilities for easily removing and securely replacing armature coils. 3. The provision of a powerful magnetic field and small armature reaction, so that the alternators shall require but little variation of exciting current to suit variation of load. 4. High efficiency both at full and light loads. The high efficiency has been obtained by the provision of an armature without any iron core, also by the reduction of the power required for the excitation of the field to a minimum, and also by the use of a light revolving armature giving a minimum of weight and loss of power at the bearings, and, as a consequence, not the least important, a minimum of trouble. The armature is of the well-known disc pattern, formed of sector-shaped coils fixed round a periphery of the hub. Probably the parent design of this type of armature is that described in Siemens's original specification of 1878; such an armature is electrically probably the best that could be devised, and it is only in the constructional details and proportions that improvements are to be looked for. The special features of the armature, as constructed by Messrs. Crompton & Co., are the methods adopted for attaching each armature coil to the centre disc or hub, and the provision made for drawing it radially inwards toward the centre so that the whole armature when mounted can be very



securely tightened up, thus entirely preventing all detrimental vibration of the armature conductor, and making a very strong and rigid job. Moreover, a new armature coil can be quickly inserted at any time and tightly drawn into place. The field magnets, bearings, and other portions of the machine, are of the usual type, and call for no description. The collector is entirely enclosed to prevent all risk from accidental contact, and the brushes are in duplicate, so arranged that either may be removed for inspection when the machine is at work. The machine illustrated is designed to work at an E.M.F. of 2,000 volts at 600 revs., and it has been in almost daily use for the past eight months. It has been frequently run for experimental purposes (with increased speed and excitation) at over 3,500 volts. The power required for the excitation of the field at full load is only 1¼ per cent. (750 watts), and the commercial efficiency exceeds 91 per cent. Messrs. Crompton & Co.'s standard sizes of these alternators range from 15 kilowatts to 200 kilowatts; those from 65 kilowatts upwards being provided with three bearings.

CORRESPONDENCE.

Mattei's Liquid Electricities.

If your correspondent had studied Count Mattei's writings he would have learnt how the Count was led to form the opinion that the liquids which he used contained electricity. He was familiar with certain effects which were produced on the nerve centres by the application of an electric current, and when he found that similar effects were produced by his liquids, he jumped to the conclusion that some of the electricity which is undoubtedly contained in every plant must, by the peculiar process by means of which he distills the essences of plants into the fluids, have been transferred to them, and that the potency of the liquids was attributable to this. Similar ideas have been held by Hahnemanian homœopathists, such as Dr. Garnier, of Nimes.

But Count Mattei does not ask his disciples to accept his opinion on this subject. He says that he himself believes the active principle in his remedies to be "electric." On page 86 of his book, however, he suggests another theory: "We may say that power of the electric kind is developed from these liquids, and from their contact with the skin where the nerves are nearest the surface." "But," he asks, "is electricity so thoroughly understood that we must believe it is only to be found in batteries and Leyden jars? And since my electricities are actually contained in the substance from which they are derived, since their action is determined by contact with the skin, I prefer to call these extraordinary remedies, these powerful principles, electricities."

I believe that every plant and animal contains electricity, and I question whether any active principle can be transferred from a plant to a fluid without at the same time transferring electricity with it. If a lump of sugar is put into a glass of iced milk, the heat contained in the sugar is diffused throughout the milk. And may it not be the same with the electricity contained in the sugar? Perhaps some of your readers can show me that I am mistaken—that there is no electricity in clouds, water, resin, cellular tissue, muscle or nerve. Till then I confess my faith that it exists in all these.

But allow me to say that it was not to this part of Count Mattei's teaching that I alluded when I wrote about its being confirmed by recent scientific research. I referred to the discoveries of M. Chazarain and Dr. Decle, confirmed this year by Dr. Luys, of La Charité Hospital, Paris, relating to the polarity of the body, and which harmonises with what Count Mattei teaches.

I notice what your correspondent Mr. H. G. Tozer says with reference to the Mattei electricities. Will you allow me to state for his information, and for the information of others of your readers who may be in danger of being led astray by his statement that the Mattei electricities have been analysed by Prof. Casali, of Bologna, one of the ablest analysts in Italy, and also by Mr. J. C. Butterfield, F.C.S., F.I.C., of London, and that the views of both these gentlemen differ from those of Mr. Stokes? The Italian professor declares that the Mattei electricities are aqueous solutions of vegetable substances. This he has proved by chemical analysis. What more there may be can only be shown by physiological experiments.

A. J. L. Gliddon.

The City and South London Railway.

At a representative meeting of electric railway employés, it was resolved that, having heard the article read *re* the above railway, which appeared in last week's ELECTRICAL REVIEW, in which the writer gives the result of his investigations into the charges of sweating, &c., preferred against the management that have appeared in letters to the *Railway Review*, *Sun*, *Evening News and Post*, &c., we are unanimously agreed that the complaints made in the letters referred to are correct, and voices the opinions of a majority of the employés, and that no exaggerations are to be found in the said letters, and that, as the writer considers that the City and South London Railway Company cannot afford to pose as philanthropists, we, on the other hand, not being capitalists, but workers for a wage only, consider that we cannot afford to pose as, or to agree with, the opinions of political economists, one article of whose creed is the obtaining of the cheapest labour in the market.

Also resolved, that a copy of the above shall be sent to the editors of the ELECTRICAL REVIEW and the *Railway Review*, in hopes of its publication in the latter journal. In addition to which, and being the author of the original letter to the *Railway Review*, I should like to point out to you wherein the ELECTRICAL REVIEW investigator has received false impressions on the subject.

The writer says that the cudgels have been taken up principally on behalf of the cleaners and drivers, which I beg to inform you is only a moiety of the truth, as the porters, drivers' assistants, and underguards' work and rates of pay are included in the principal theme. The drivers, guards, and all that have to run with the trains, know well enough that they cannot expect regular or any meal times; but what they do expect is, that their pay should be commensurate with the duties they are called upon to perform—or, in other words, that a cleaner should not be called upon to perform drivers' assistants' work, without receiving the lowest scale of assistants' rate of pay, or that a porter should not be called upon to perform underguards' duties without receiving the lowest scale of underguards' rate of pay, &c., and that it is nothing short of sweating that it should be otherwise; as, for another example, that men who have been running as assistants for two years and upwards should still be in receipt of 3s. and 3s. 1d. per day only, or that drivers who have been running for the same period should still be in receipt of a shilling per day less than the majority. Your writer also finds that the men are paid even more liberally than men on other railways, taking into consideration their hours, duties, and capabilities. Here, again, I am compelled to disagree with him, for surely 8½ or 9 hours' high pressure, continual running through the "pipe" without any appreciable intermission, is worse than 10 hours' running in the open air with intervals of rest at terminal stations; and the duties are just as onerous as upon other railways, viz., to get the passengers in and out of the trains, and to their destinations, as safely and as quickly as possible. Then I think that the capabilities of the majority of the men are quite equal to, if not greater than, the capabilities of men on other railways, for this one reason, that they have proved themselves in the past capable of working trains by steam power under ordinary conditions of service, and now, in addition, have also proved themselves capable of working trains by electric power under totally different conditions, and, in fact, my opinion of the men's intelligence, &c., is very high, and am sure it would compare most favourably with that of any other body of railway men, with one qualification, and that is, that they do not use their intelligence sufficiently in one direction, viz., that of organising themselves for the purpose of obtaining better conditions of pay, hours of labour, and treatment generally. In conclusion, just a few words about the stoker's occupation having gone, and that lads of 16 or 17 are good enough for drivers' assistants, or that drivers are paid liberally for doing nothing.

Although the assistants have no coals to shovel upon a fire, or water to keep up in the boiler, from what I have seen

and know of them and their work, I think they are pretty generally occupied, for at least once in about every 20 minutes they have to uncouple and couple up again, take supplies of air at Stockwell end, fill up carbon holders, keep the whole interior of the engine clean and bright, help the driver in looking out for signals, work the hand brake, and, in the event of a failure, walk through the tunnel to obtain assistance. Then should a driver become disabled by sudden illness or accident while running in the tunnel, fancy a boy of 16 or 17 being in charge of the engine and lives of the passengers behind him. And as to the drivers, I think that all of them would be only too glad to return to the old steam power engine, with its alleged harder work, longer hours, greater responsibilities, and last but not least, its well known bigger pay.

"Live and let Live."

[Our correspondent does not comply with the rules of journalistic etiquette, by concealing himself behind a *nom de plume* and omitting to enclose his real name, but lest we should be considered unjust to the railway men, we insert his letter, though it is contrary to a rule generally enforced by us and the editors of other papers, not to insert communications from correspondents who do not choose to disclose their identity. We did not presume to discuss the vexed question of the "living wage" at present receiving so much attention; our statements were put forward as comparative ones, and we again repeat that from data we have perused we understand that the City and South London employés are, many of them, earning higher wages than they were in receipt of from other railway companies previous to entering their present employ. We would appeal to the men from common sense grounds. Here is a company worked for the most part by the capital of a number of City business gentlemen, who justifiably look for a good return upon the money laid out. They have never yet received 1 per cent. upon their ordinary capital, and if the wages bill were much increased it might ere long become a question for these shareholders to decide as to whether the concern shall be operated without yielding any reasonable return, or winding up altogether. The workmen would, in the latter case, be compelled to seek their fortunes elsewhere, and the "half-a-loaf" which they allege they now receive is surely preferable to "no bread." The whole matter is bound up in that problematical and elephantine question, "the living wage," which is not a fitting subject for discussion in the technical journals, but must be threshed out in Parliament, if a solution is ever to be arrived at. We venture to predict that when it comes before the Government it will be a measure equal in tediousness and importance to the now extinct Home Rule Bill, and may perchance meet in the end with a similar fate.—EDS. ELEC. REV.]

The Relative Merits of Working Hoisting-Machinery by Steam, Water and Electricity.

I observe that in this week's issue of the ELECTRICAL REVIEW you have been good enough to notice the paper I prepared for the Engineering Congress held at Chicago this year; but while appreciating the prominence you have given it, I must take exception to some of your opening remarks.

It appears that you are under the impression that I was injudicious enough to base my arguments on the electric working of hoisting-machinery on one installation only, viz., the Southampton one; but as a matter of fact, I investigated and tested several plants, so can only conclude that your not having had my remarks *in extenso* is the cause of the misconception.

My paper clearly states, under headings (1) Test; (2) Test, &c., page 613 of your issue, that there were several tests, and carried out on travellers of different types, while it is only the fourth test that applies to the "Southampton cranes," and it is the omission of these words that appear to have given rise to the error.

The table in Appendix 1 of my paper (a full copy of which I enclose) gives detailed results of the tests I made, and which I think are of sufficient interest to warrant your publishing, and, at the same time, may I ask you to kindly notify your readers that the basis of my remarks was not so curtailed as you have led them to believe?

Again, the last paragraph in your extract is worded in a way that would lead one to suppose I advocated hydraulic power generally, to the exclusion of electricity; but this is far from being the case; the paragraph referred to only related to the Southampton plant.

In the very first page of my orignal paper I state:—

"The author cannot urge too strongly the fact that each installation should be specially and individually considered. The advantages and disadvantages that would accrue from the application of each should be considered, with the result of selecting the one which shows least objections, for no doubt none would be perfect."

In conclusion, I would inform you that my object in writing on this subject was in no way to advocate any particular system of power, but rather to investigate and point out the advantages and disadvantages of all, so as to draw out as full a discussion as possible, so your further remark: "He might have seen no cause to alter his opinion, &c.," is not applicable, for I expressed no hard and fast opinion whatever.

George A. Goodwin, A.M.I.C.E.,
Whitworth Scholar.

Information Wanted.

Any reader of the ELECTRICAL REVIEW who can recommend a flux—not borax—for soldering nickel to platinum will greatly oblige.

A. S.

FUEL ECONOMY.—We have received a letter on this subject from Mr. Wm. Boby, which we are compelled to hold over until next week, owing to its late arrival.—EDS. ELEC. REV.

LEGAL.

STRICK *v.* LATIMER CLARK, MUIRHEAD & CO.

IN the Queen's Bench Division of the High Court of Justice, on Tuesday, this case came on for hearing before Mr. Justice Wills. Mr. McCarthy was counsel for the plaintiff; Mr. Lockwood, Q.C., and Mr. Pollard appeared on the other side.

Mr. JAMES STRICK, the plaintiff, said that in 1889 he introduced the defendant company to the Westminster Electric Supply Corporation, which had been formed for the purpose of acquiring the parliamentary rights for the lighting of Westminster. The arrangement was that Messrs. Latimer Clark were to assist the corporation in obtaining the provisional order from the Board of Trade, and that in the event of success an order was to be given to the defendants for £100,000 worth of plant. Throughout the entire business it was thoroughly understood that Mr. Strick was to be paid a commission or bonus by Messrs. Latimer Clark & Co. The provisional order was obtained on May 20th, 1889. In December disputes arose between the present defendants and the Westminster Corporation, and Messrs. Latimer Clark, Muirhead & Co. brought an action for specific performance of the contract or damages. The case came on for trial in April, 1891, before Mr. Justice Hawkins and a special jury. On the second day of hearing the matter was settled. Messrs. Latimer Clark & Co. accepted £4,000 for damages and costs, it being understood that goodwill was to be restored and business relations resumed. Mr. Strick saw one of the defendants as he was coming out of Court, and he said to him, "You know you are financially interested in this, Mr. Strick?" The plaintiff replied, "Yes, I am." Eventually he asked that his commission should be paid, but Mr. Latimer Clark said that they only paid commission on completed work, not on damages.

Cross-examined by Mr. LOCKWOOD: Mr. Brown Martin was chairman of the Westminster Corporation. He (plaintiff) contemplated that he would be appointed the manager, but, as it turned out, he did not obtain any position on the Westminster. He was the secretary of a metal company, of which Mr. Brown Martin and Mr. Latimer Clark were directors. He did not know that the defence set up by the Westminster Company in respect of the action brought against them was that Messrs. Latimer Clark, Muirhead & Co. were not to have the contract until they should have handed in subscriptions for £16,000. He had heard it was so since. He had several interviews with Mr. Frank Muirhead (who was brought to him by Mr. Latimer Clark) about the business. Mr. Muirhead said he would, of course, provide a commission for him.

In reply to his Lordship, Mr. LOCKWOOD explained that first of all his clients disputed that the introduction was brought about by Mr. Strick; but this gentleman had rendered some service in procuring the signature of Mr. Brown Martin to a letter in April. For that they always intended to make the plaintiff some remuneration, and they had paid £40 into Court, believing 1 per cent. upon the £4,000 to be a fair rate. The defendants further thought there had never been a binding and definite contract with the Westminster Company, but that the document of December 5th was really dependent upon their obtaining a certain amount of share capital. That was why Messrs. Latimer Clark were advised to settle the action against the Westminster for £4,000.

Further cross-examined by Mr. LOCKWOOD, the plaintiff said he was not aware the defendants had sent in tenders to the Westminster Company prior to his intervention.

Mr. BROWN MARTIN, director of the Westminster Electric Supply Corporation, said he had known Mr. Latimer Clark for some years. The defendants were a well-known electrical firm. They assisted his company considerably in the enquiry before the Board of Trade. They were to have no remuneration apart from obtaining a portion of the contract work. Mr. Muirhead's brother was a partner in the firm of Scott & Co., the brokers who obtained the capital for the Westminster Company. The settlement for £4,000 was to wipe out everything. He believed Mr. Strick introduced Mr. Frank Muirhead to him.

This was the plaintiff's case.

Mr. POLLARD said it was always intended to give Mr. Strick a gratuity, and that would have been done had not a claim been made for commission. They had paid into Court £40, representing 1 per cent. on the £4,000, although that amount included the costs of very heavy litigation.

Mr. FRANK MUIRHEAD stated that he mentioned to Mr. Clark that he had sent in a tender to the Westminster Company. Mr. Clark told him to see Mr. Strick, who was the secretary of a metal company of which he was a director, and who was going to be the manager of the Westminster. Mr. Strick introduced him to Mr. Brown Martin. He knew that Mr. Brown Martin was concerned in the enterprise. Witness could not get to see Mr. Brown Martin to sign the memorandum embodying the terms of the arrangement. Mr. Strick undertook to get it done. He never promised the plaintiff commission.

Cross-examined: When Mr. Strick obtained the signature to the letter, it was said he should be remembered. They assisted him in obtaining employment with the St. James's Company.

Mr. JOHN MUIRHEAD, managing director of the defendant company, denied that he ever promised the plaintiff a payment on account of commission or otherwise. The matter was not in his hands.

Mr. MURDOCK, secretary to Messrs. Latimer Clark, Muirhead and Co., having been called,

Mr. POLLARD mentioned that Mr. Latimer Clark was suffering from influenza, and was not present.

Mr. JUSTICE WILLS said that in cases where there was a conflict of testimony the correspondence was very material. Here the plaintiff had made his claim for commission at the earliest moment. He had come to the conclusion that the plaintiff here was entitled to recover, and he assessed the amount at £300, or £260 beyond the amount paid into Court. Judgment would be entered accordingly, with costs.

NOTES.

The Council of the Institution.—It will be seen from the abstract of a memorial on another page that things were ripe for a conflict at the Institution meeting to be held last night. There is an opinion that the claims of telegraph and telephone men for a seat on the Council have been overlooked. We took considerable trouble last year to show that this grievance was more fancied than real, and that very few branches of the electrical profession were neglected. Perhaps if the malcontents, we don't use this term disrespectfully, had asked that the Council be increased in size, they would have had a stronger case, for it is impossible to say of any single member of the present council that he is not a distinguished man, and that he has anything but a real interest in electricity and its applications.

The New Cable.—From the *Canadian Gazette* we cull the following memorandum prepared by Mr. Sandford Fleming and submitted to the various Australasian Governments. Four possible routes for the new Canadian-Australasian cable were named as follows:—1. *Viâ* Fanning Island, Fiji, and New Zealand, or Norfolk Island, New Zealand, and the Tweed Heads. The distance, including the branches, would be 7,145 knots, and the cost, £1,678,000. 2. *Viâ* Necker Island and Fiji, a length of 7,175 knots, would cost £1,585,000. 3. *Viâ* Necker and the Gilbert Group, with branches to New Zealand and Queensland, 8,264 knots, would cost £1,825,000, 4. From Canada to Bowen, touching at the Gilbert Group and the Solomon Islands, 6,244 knots, would cost £1,380,000, or with a special cable from the mainland to New Zealand, 7,310 knots, at a cost of £1,610,000. It is suggested that whichever route be selected, should be worked under the joint ownership of Australia, New Zealand, Fiji, and Canada, as a public undertaking, taking over the existing obligations of the Eastern Extension Company. The money for the outlay could be borrowed at 3 per cent., and it is believed that within three years the revenue would be sufficient to meet every charge.

Admission, Sixpence.—*Pro Bono Publico*, writing to the *Derby Advertiser*, suggests that the public who are curious to know how electricity is produced should be allowed to go over the generating station at Derby at a charge of 6d. for each person. This inspection, he says, would, of course, be made when the lights were on and the machinery in motion. This might interest the public, but would it assist those in charge of the station to have crowds of inquisitive spectators gathering around them during the busy hours of supply? Further, we would suggest that the machinery and plant be labelled as are wax figures, and the like, at exhibitions, museums, &c., "Visitors are requested not to touch." Otherwise it may cost more than 6d. per visitor.

Chicago Railways.—The officials of the Chicago City Railway are desirous of doing that which is gradually being accomplished in all parts of enterprising America, *i.e.*, to abolish horse traction and adopt electric. The overhead trolley is the system expected. The company has at present about 100 miles operated by animal power. According to the *Street Railway Review*, the municipal authorities are offering opposition to the overhead wires, more especially so far as certain thoroughfares are concerned. When the consent is granted, if it ever is, several months must necessarily intervene in which to build machinery, equipment, and erect power houses. Our contemporary says the objections raised on account of possible electrolytic action might have had weight ten months ago, but with the recent solutions of this problem, it no longer stands as a valid barrier.

Royal Institution.—The following are the Lecture arrangements before Easter:—Prof. Dewar, six lectures (adapted to a juvenile auditory) on "Air: Gaseous and Liquid;" Prof. Charles Stewart, nine lectures on "Locomotion and Fixation in Plants and Aminals;" the Rev. Canon Ainger, three lectures on "The Life and Genius of Swift;" Mr. W. Martin Conway, three lectures on "The Past and Future of Mountain Exploration;" Prof. Max Müller, three lectures on the "Vedânta Philosophy;" Prof. W. H. Cummings, three lectures on "English Schools of Musical Composition" (with musical illustrations); The Right Hon. Lord Rayleigh, six lectures on "Light, with special reference to the Optical Discoveries of Newton." The Friday evening meetings will begin on January 19th, when a Discourse will be given by Prof. Dewar on "Scientific Uses of Liquid Nitrogen and Air;" succeeding Discourses will probably be given by Mr. A. P. Graves, Mr. T. J. Cobden-Sanderson, Prof. W. F. R. Weldon, Prof. Silvanus P. Thompson, Prof. John G. McKendrick, Dr. W. H. White, The Right Hon. Lord Rayleigh, and other gentlemen.

The Pathological Aspect of Electric Lighting.—The following interesting paragraph appeared in the *Lancet* for Saturday week, from the pen of the Parisian correspondent of that paper:—"At a meeting of the Academy of Medicine held on the 21st inst., M. Lancereaux exhibited the lungs of a polisher of carbon terminals for the electric arc light, the said organ being transformed into veritable blocks of carbon, and large vomicæ being also discovered. The deceased was, up to the age of 36 years, a vigorous stonemason. He was then transferred to a workshop 8 metres long by 7 broad, where, with eight other men, he was engaged in polishing on stone mills charcoal for electric lighting purposes. The shop was so badly ventilated that sometimes the men could not distinguish each other through the charcoal and stone dust filling the atmosphere. The man continued to work thus for six years, each day's work extending to 10 or 12 hours. For a year before he ceased work altogether he had coughed and expectorated black sputa. He was admitted into hospital in the winter of 1890-91 for bronchitis after influenza, and he was then expectorating black sputa in large quantities, in which particles of carbon could easily be distinguished under the microscope and by chemical tests (resistance to strong acids). In 1892, he was readmitted in an emaciated condition, and bacilli could be detected in the black sputa secreted by the numerous cavities. M. Lancereaux very truly says that every new industry that springs up is worthy of the physician's notice, in that new dangers to health may thus be created. He claims for the modern class of toilers better ventilated workshops. Strange to say he does not suggest the employment of respirators as well."

Russo-Chinese Telegraphs.—A second telegraph line is about to be constructed between Wladiwostock and Wenchuen.

Italian Telegraphs.—The total number of offices open up to the year ended 1892 was 4,360, and the number of telegrams despatched was 9,097,821, and received, 11,185,432. In addition to these, 19,467,196 through telegrams were dealt with, making a total of 39,750,449. The total length of wire in use was 145,539 kilometres; the total length of line being 38,108 kilometres.

Fuel Economy.—Some time ago we made some comments regarding the economical advantages of oil as fuel compared with coal, in connection with the use of the former at the World's Fair. We are now interested to learn that only one-fourth the number of men were required in the boiler room at Chicago as would have been the case if coal had been the fuel used, while the uniform steaming qualities were specially marked.

Cable Communication.—The following is a note of cables interrupted and repaired:—Saigon-Bangkok, interrupted November 1st, repaired November 13th; Perim-Obock, interrupted November 10th, repaired November 17th; The following cables are at present interrupted in addition to those mentioned by us last week:—Brest-St. Pierre, of Anglo Company, interrupted April 6th; Shanghai-Amoy, interrupted September 26th; Paramaribo-Cayenne, interrupted October 25th.

The Telephone in America.—In a paper read by Mr. O. D. Lockwood before the Congress on Patents, Chicago, it was stated that since the first patent on the telephone was granted 17 years ago, there were granted in the United States 770 patents relating to telephones and 2,110 patents relating to telephone appliances. An examination of the statistical diagrams found in the exhibit made by the American Bell Telephone Company at the World's Fair indicates that at the beginning of 1893 there were in use in the United States alone, in round numbers, 440,800 miles of telephone wire, of which 91,500 miles were underground; 552,700 telephones and 1,350 telephone exchanges; that connected with these exchanges there were over 232,000 subscribers; that the number of connections between the lines of these subscribers in a year reaches the figure of 600,000,000; and that the telephone exchanges provided employment for 10,000 persons.

The Northern Society of Electrical Engineers.—Within the last few weeks a new society, with the above name, has been founded, with its headquarters in Manchester, "To hold meetings for the promotion of electrical science, and its commercial and other applications, and for social intercourse between members." It has for some time past been felt that little or no opportunity has been afforded the members of the electrical profession and trades—now very numerous—in the Midland and Northern Counties of meeting outside London, for the purpose of scientific discussion and social intercourse. A movement was recently set on foot by two or three gentlemen in order to bring some local members of the profession together to discuss the matter. The result has been that the new society has been founded. It is pointed out that the society is not founded with any view of rivalry or opposition to the existing Institution of Electrical Engineers, but simply to enable members of the profession, who are unable to attend meetings in London, to do so in the provinces, and at the same time to become better acquainted with each other. A considerable number of gentlemen have already joined the society, and invitations have been posted to members of the profession within range of Manchester, inviting their co-operation. At present it has been decided to hold the meetings in Manchester, but it is expected that at an early date meetings will be arranged for at other important provincial towns. The Honorary Secretary is Mr. John Darney, 102, Portland Street, Manchester.

Bristol Exhibition Lighting.—The amount of light to be consumed at the Bristol Industrial Exhibition is equivalent to 2,000 8-C.P. lamps.

Cork Tramways.—There has been a great deal of talk at Cork in opposition to the use of overhead wires on a system of tramways being promoted. The company's directors have now sought power to alter the Corporation's resolution on the subject, making the working of the tramcars by electricity or horse power optional, which is the desire of the promoters, and this has been agreed to by the Corporation.

Bristol Electric Lighting.—Mr. Preece has recommended the Electric Light Committee to immediately obtain two additional dynamos, which it is estimated will cost, with their engines, about £5,000. The committee have five dynamos at present, and these include two large size ones, but these are evidently insufficient to cope with the expected demand.

The Institution of Electrical Engineers.—As we go to press we hear a rumour to the effect that there is likely to be a stormy meeting at the General Meeting of the Institution of Electrical Engineers, over a memorial which we understand is to be presented. It will be signed by a number of the leading cable, railway, telegraph, and telephone men, and also by some other well known electrical names. It will be remembered that in the year 1889 the composition of the Council, and their recommendations for the filling of the positions thereon then vacant, gave rise to so much dissatisfaction and complaint, that a protest was addressed to the members of the Society and to the Council against the manner in which telegraph and telephone interests had come to be ignored in the composition of the Council. The discontent assumed such proportions, that the Society stood in grave danger of a split, which, however, was happily averted by the frank manner in which the Council admitted the just claims of the telegraph and telephone professions to a fair amount of representation, and agreed to restore the balance at the first opportunity. Accordingly, at the next election, four representatives of these branches were recommended by the Council, and duly elected. Year by year, however, as these particular representatives retired, the Council, instead of continuing the policy which they had admitted both directly and by their action to be just and reasonable, and proposing the election of other representatives from the same professions as the retiring members, did in no case follow that principle, but recommended the election of other gentlemen from professions already fully represented, until, with the disappearance of the telephone representative in the present year, the last trace of the successful agitation of 1889 has disappeared, and once more private and railway telegraphs and telephones are unrepresented, except among the past and vice-Presidents, who *ex officio* are irremovable. The memorialists suggest:—
1. That the 12 ordinary members of Council should, as far as possible, consist of representatives of the following branches of the electrical profession in something like the following proportions:—

3	members	representing	Pure Science.
2	"	"	Electric Lighting.
2	"	"	Postal Telegraphs.
1	"	"	Railway Telegraphs.
1	"	"	Private Telegraphs.
1	"	"	Telephones.
2	"	"	Manufacturers.
12			

2. That when any of the representatives of any of the above branches retire, the vacant seats shall be filled up by representatives from the same branches, so as to secure the permanent representation of the various branches in the fixed proportions agreed upon. 3. That it shall be competent for any 12 members, including proposer and seconder, to propose the election of a representative for the vacant seats, and on receipt of such nominations the names of the nominated person or persons shall be included in the balloting papers; such nomination papers to be in the hands of the secretary not later than November 1st in each year.

The Society of Belgian Electricians.—M. Banneux, Director of the State Telegraphs, has been elected president of the Belgian Electricians Society.

Lectures.—A lecture was delivered last Monday evening in the Chemical Theatre of the Owens College, Manchester, by Dr. Edward Hopkinson, on the subject of "Electric Railways."

Brazilian Telegraphs.—The total number of telegraph offices open at the end of 1891 was 212, and the total receipts for the year 6,958,517 francs. The expenses amounted to 8,354,263 francs.

Electric Launches for Sale.—In our issue for November 17th we published some statistical notes regarding the electric launches which had been on exhibition at the World's Fair. From advertisements in the American papers just to hand, we observe that a number of these launches are being offered for sale by the Electric Launch and Navigation Company, of 44, Broad Street, New York.

Church Lighting.—Rev. Dr. Macdonald, the pastor, has undertaken to bear the cost of lighting Green Hill Church, Derby, with electricity, the estimated amount being £120.

Electrical Engineer Committed for Trial.—Henry Everard Hunt, the manager of the Taunton Electric Light Works, to whom we referred in our last issue, has been committed for trial on charges of forging and uttering two promissory notes for £233 and £44 with intent to defraud. The prisoner was entrusted with money to pay coal bills of the company, and instead of disbursing it, he, it is alleged, appropriated the amounts stated to his own use.

Liverpool Overhead Electric Railway.—In the House of Commons last week Mr. Snape asked the Secretary to the Treasury whether the Overhead Electric Railway at Liverpool had been assessed to the passenger duty; and, if so, on what terms. Sir J. Hibbert: No assessment has yet been made. The Board of Inland Revenue are in correspondence with the company on the subject, with the view of determining the terms of charge.

Action against the St. James's and Pall Mall Company.—The St. James's and Pall Mall Electric Light Company have been engaged in, perhaps, more legal fights since their formation than any other similar company in Great Britain. Only a few weeks ago they lost an action taken against them by some of the founders' shareholders. They appealed, with the result that they were dismissed. This has hardly blown over, when the St. James's Vestry threaten proceedings against them on two important points—(1) for turning into the sewer scalding water and steam in such quantities as to constitute an improper use of sewer, and to cause inconvenience and annoyance to the neighbours and to the sewer-men. (2) The Vestry have had repeated complaints of offensive smells proceeding from the electric lighting station in Mason's Yard, and they have decided to take action on this point as well.

The Société Française.—The Société Française d'Encouragement pour l'Industrie Nationale will, in 1896, award the Melsens prize of 500 francs to the author of an application of physics or of chemistry to electricity, ballistics, or hygiene. Prizes will also be awarded in 1894 and 1895 for a motor of less than 50 kg. weight per horse-power (3,000 francs); for an oil motor (1,000 francs); for an engine of 25 to 100 horse-power, using as a maximum 7 kg. of steam per horse-power hour (3,000 francs); for a domestic motor (2,000 francs). A prize of 2,000 francs will also be given for a process for the industrial production of ozone, and for its applications. A prize of 3,000 francs will be awarded for a material as a substitute for gutta-percha, and also for work in connection with developing the production or economising that gum. A prize of 2,000 francs will be given for an apparatus or industrial process which enables the insulation of various parts of a working electric installation to be measured.

Central Stations in France.—Messrs. Baudry & Co., of Paris, have brought out a 32-page pamphlet, giving very complete details of the electric lighting stations in France. The price of the book is 3 fr. 50 c.

Tram Accidents in Paris.—The other night, about 12 o'clock, a tramcar belonging to the Chapelle-Square-Monge line was stopping at the office, situated at 75, Rue de la Chapelle, when an electrical car coming from St. Denis ran into it, the driver being unable to check the speed of his vehicle. The shock was so great as to smash the platform of the first car. Two men were injured.

About midnight, one day last week, an electrical tramcar broke off the custom house barrier at St. Ouen, which was half opened, and threw it to a distance of 10 metres. The employés and passengers were somewhat shaken and bruised.

CONTRACTS OPEN AND CLOSED.

OPEN.

Fermoy.—No date stated. Lighting the town by electricity for the Town Commissioners for a period of 12 months, in substitution of the 81 gas lamps now in use. Tenders to Mr. P. L. Lane, Town Clerk, Fermoy, co. Cork, Ireland.

Harrogate.—December 30th. Tenders for concentric insulated cables for high pressure distribution. Full particulars will be found in our advertisement supplement.

CLOSED.

Bolton.—The contract for switchboards and connections for the Bolton Corporation has been placed with the Manchester Edison-Swan Company, Limited.

Dundee.—Tenders for the installation of the electric light in the Central Police Station, Dundee, were submitted to the Finance Committee of Dundee Police Commission last week, when the offer of Messrs. D. & G. Graham, Glasgow, was accepted. Messrs. Graham have contracted to execute the work at a cost of £107 17s. 6d., £40 less than the lowest of any of the Dundee firms which tendered.

At the meeting of the Works Committee of the Water Commission on November 30th, the City architect reported that he had accepted a tender for fitting up the new offices with electric light, *i.e.*, that of Messrs. Norman & Son, Limited, of Glasgow, for £185.

Newport.—Eleven tenders were received for the erection of electric lighting station, and that of Mr. Wm. Gradwell, of Cardiff, at £4,750, was accepted. The next lowest tender, that of Mr. J. H. Firbank, Newport, was £5,080; and the highest, that of Mr. C. H. Reed, Newport, £5,984. No fewer than 52 separate tenders for the supply of electric plant were received, and these were referred to Mr. Hammond, the engineer, for examination and comparison.

BUSINESS NOTICES, &c.

The Universal Electrical Directory (J. A. Berly's), now under the direct supervision of the proprietors, H. Alabaster, Gatehouse & Co., is in active preparation for the 1894 edition (13th year). This is a directory of the electrical trades embracing the whole Universe, and having no superfluous matter irrelevant to a directory it can be sent anywhere, carriage paid, for 4s. It is indispensable to all having business transactions in the electrical world, and once used cannot be done without. Advertise in it! Order it! It will prove the best outlay ever made.

Weybridge Electric Lighting.—Prof. Alex. B. W. Kennedy has submitted his report to the Weybridge Electric Supply Company, regarding the lighting station. After commenting favourably on the condition of the machinery, &c., he says, "As to the system adopted, I can say at once that it is practically the only system by which, at any reasonable cost the electric light can be introduced into a large and straggling district such as Weybridge. . . . I think the charge of £2 5s. per lamp per annum really appears to be very much too small, and I should hope that if the work is taken up locally a very considerable increase, say not less than 50 per cent. on this, can be obtained. As to the quality of the lighting, I can only say that during the night I spent in the station the regulation could hardly have been improved upon. I watched the pressure continually, and found it to remain practically invariable, and the steadiness of the lamps left nothing to be desired." After going thoroughly into financial questions, Mr. Kennedy alludes to the proposal to establish a local company which should take up the existing plant, add to it, and lay the mains underground, replacing at the same time the

wooden lamp-posts by iron ones. From documents which he has seen he estimates that the total cost of the existing and extended plants, with the underground mains (about 6 miles of road-work and 13 miles of cable) fully laid, to any new company would be about £16,000. The total income from the extended plant, if it were completely utilised, would be £1,755. If the price for public lamps was raised to the reasonable sum of £3 7s. 6d., the income from that source would be £412, making a total of £2,167. The working expenses are estimated at £1,305, leaving a difference of £862. That would suffice for the payment of 3½ per cent. on £16,000, which would absorb £560, leaving a balance of £302 to form the commencement of a reserve or depreciation fund. In conclusion, Mr. Kennedy says: "I have no hesitation, therefore, in saying that if your demand for private lighting could be increased from the present number of 22 to about 75 or 80 consumers, assuming the average number of lamps installed by each one to remain as at present, the company would pay a small dividend on £16,000, besides putting a small sum to reserve. The required increase in the number of consumers would not, of course, take place all at once, but if the matter were taken up locally and pushed with vigour, I do not think there should be much difficulty in obtaining the required increase. Of course, the company might go on and pay its way with a much smaller number of houses connected, but I believe that the number I have mentioned is about the smallest which could enable a reasonable dividend to be paid. On the other hand, after this number was once reached, any increase in the consumers would be accompanied by a very much larger proportionate increase in the profits."

Larne Electric Lighting.—On 4th inst. a meeting of the Commissioners was held for the purpose of deciding the question of the lighting of the town for the ensuing three years. The chairman said the principal business to come before the board was the consideration of tenders for the lighting of the town. They had received two tenders—one from the electric light company (the present contractors), and the other from the gas company. He would call on the clerk to read the tender and specification of the electric company, in which they offered to light the town with 11 arc lamps of 1,200 candle-power at £11 each per annum; six incandescent lamps of 32 C.P., £4 each per annum; 66 incandescent lamps of 16 C.P., at £2 each per annum for the term of three years from August 1st, 1894, from dusk to midnight in every day, from August 1st till the last day of the succeeding April, except that no public lighting shall be required for three days before and two days after the full moon in each month. In the event of any failure of the lighting of the town, the contractor will forfeit, in each instance, a sum equal to the cost of lighting during the said period of failure calculated at the price set out. The electric company were of opinion that the Commissioners might do well to purchase the electric light installation, spreading the payment over a term of years. The tender of the electric company was considered a very fair one by the majority of the Commissioners. The clerk drew the attention of the Board to the fact that the electric company quoted at so much per annum, and perhaps they would make an allowance for the three months that they would not be required to light. The clerk read the tender of the gas company. The majority of the board were of opinion that it would be well to have a clear understanding with the electric company with regard to their price before deciding in the matter. The question was allowed to wait over for a few days in order to allow time to the electric company to reply.

Electric Light at Wolverhampton.—At the Wolverhampton Town Council on Monday, a report was presented by the Lighting Committee with regard to the scheme for supplying the electric light to the town. Originally a tender by the Electrical Construction Corporation to lay down the plant for a sum of £28,772 10s. was submitted for approval, but, since the appointment of Mr. F. Harman Lewis as electrical engineer to the Corporation, the scheme has been revised with a view to sub-dividing the contract. It is now proposed to provide a generating station in Commercial Road, from which the electrical energy will be transmitted to a central switch station at the Town Hall. From this central station the high-pressure current will pass to various sub-stations in the compulsory area, which will be at the Art Gallery, Free Library, and Town Hall, where it will be transformed into low-pressure energy for distribution. The total amount of the new tenders, plus £1,320, estimated for arc lamps, is £18,762 14s. 2d., as against £28,772 in the original estimate. Other items of necessary expenditure will reach £4,020, and the total amount of capital expenditure for which a loan is sought will be as follows:—Plant, £17,442 14s. 2d.; arc lamps, &c., £1,320; other capital items, £4,020; cost of buildings and contingencies, £7,228 5s. 10d.; total £30,011. Attention is directed in the report to the great reduction in the present tenders. The Local Government Board will be asked for sanction to a loan of £30,000.

Electric Lighting of Richmond Main Sewage Works, Mortlake.—Messrs. Drake & Gorham have now completed their contract for the electric lighting of the above, and the stipulated trial run of 12 hours continuously of the whole of the plant with all the lights on, proved very successful. The formal taking over of the plant was celebrated on Saturday the 4th inst. 56 lights of 8, 16, and 32 C.P. are installed for general purposes, 4 of 300 C.P. for lighting the engine room, and one of 400 C.P. for illuminating the outside tanks. The dynamo fixed is a compound wound machine of the Electric Construction Company type, wound for 105 volts at 60 ampères, running at 1,400 revolutions per minute. It has been decided to utilise the existing engine for the electric light. It is of the Marshall vertical type, running at 150 revolutions per minute, and a Pickering governor was added to the engine to suit the electric light plant. Special precautions have been taken in the well and mixing room on account of the amount of moisture always present. Mr. A. H. Preece acted as adviser to the board.

Royce & Co. v. Feller.—This was an action which came on at Hull, by Messrs. Royce & Co., electrical engineers, of Manchester, against Mr. Feller, the proprietor of the Imperial Hotel, Hull, in respect of his electric lighting installation. It appeared from the evidence that Messrs. Royce approached Mr. Feller with the view of lighting his hotel by electricity, and an estimate was given of the cost, which stipulated for the supply of accumulators and everything necessary for the complete installation of the lighting, and also that Mr. Feller should be allowed five per cent. discount for cash on completion. The plaintiffs alleged that the work was completed, and sent in an account for the amount due to them, including some extras agreed on. The defendant objected to some of the items in the account, and the plaintiffs replied that he had forfeited his right to the discount. Mr. Feller immediately forwarded his cheque for £420, being the amount of the claim by the items objected to and discount. The plaintiffs admitted that they had agreed to forego all further claim if the defendant would sign a certificate that the work was complete, and to his satisfaction. This he refused to do, and the action was thereupon brought for the amount in dispute. The action was for £27 8s. 8d. The defendant having obtained other advice, alleged that there were some serious departures from the estimates, and filed a counterclaim, but it was objected to as not being in time, and his Honour allowed the objection. After legal arguments on the question whether the plaintiffs' acceptance of the defendant's cheque was not an acknowledgment of the defendant's claim for discount, his Honour reserved his decision until the next Court, to allow of defendant's counterclaim to be heard for damages in respect of the alleged breaches by the plaintiffs of their contract.

Telephone Tubes in the City.—At the meeting last week of the City Commissioners of Sewers, a letter was submitted from the City of London Electric Lighting Company, Limited, asking the commission to end the present deadlock as to the telephone tube question by giving their consent as required by the Telegraph Act, 1891. The company first controvert the assertion that the tubes were laid simultaneously with the electric lighting apparatus without the knowledge of the commission. With reference to the conditions which the commission sought to impose on the users of the tubes—to grant a telephone service within the City at £8 per annum—the company were informed by the highest authorities that that was incompatible with an adequate return on the capital invested. No company had an exclusive right to supply telephone service in any part of the kingdom, for the Post Office authorities had repeatedly expressed their willingness to open exchanges if a certain number of subscribers asked them to do so, and, as they could carry out such a service more cheaply than a private company, any risk of a monopoly at once vanished. The existence of that powerful check against exorbitant charges would seem to render unnecessary a resort to exceptional measures. The company was erecting plant, &c., to supply 25,000 customers with electric light. If the revenue derived from telephone tubes be reduced to please 3,000 citizens it could only be at the expense of 25,000. In the meantime the tubes were lying idle, neither benefiting electric light users nor telephone subscribers. The existing companies were every day putting numerous wires overhead which might, in many cases, be placed underground. The letter of the company is now under the consideration of the Commission of Sewers.

Glasgow Electric Lighting.—The Lord Provost in his review of the year says: "In connection with the gas and electric lighting department, two important works have been completed during the year. The new electric light station in Waterloo Street was opened on February 25th last. This station was designed for the supply of electricity within the central area of the city, and the building and plant originally put down, including the street mains, have cost about £80,000. The plant at first put down was to supply about 12,000 lamps of 8-candle-power, but so great has been the demand for the new illuminant that as many as 15,000 lamps of 8-candle-power have been supplied, while the number of consumers is still increasing, and the committee have had to give authority to the electrical engineer to lay down additional distributing mains, and additional engines, boilers, and dynamos have also been ordered. The third branch of work that the Watch and Lighting Committee has in hand is the lighting of the city. Here the feature of the year has been the introduction of electricity as a street illuminant. Since February 25th, when the current was switched on, we have had the main arteries of traffic in the central area of the city lighted by that agent—from Charing Cross to Glasgow Bridge, Buchanan Street, and George Square; and even now, as the progress of the railway works renders it possible, we are having electric light pillars erected and lighted along the main thoroughfare of Argyll Street and Trongate from the site of the old Gushet House, Anderston, to the Cross. Not many improvements have secured a more general and hearty approval from the citizens."

Newington, Priddle, & Co., Limited.—A petition for the winding up of the above company by the High Court of Justice, was, on December 9th, presented by John Bilbie and Tinsley Waterhouse, trading as Bilbie, Hobson, & Co., of 80, Queen Victoria Street, E.C., engineers, creditors of the said company. The petition is directed to be heard before the Court sitting at the Royal Courts of Justice, Strand, W.C., on December 20th, 1893; and any creditor or contributory of the said company desirous to support or oppose the making of an order on the said petition, may appear at the time of hearing, by himself or his counsel, for that purpose; and a copy of the petition will be furnished to any creditor or contributory of the said company requiring the same by C. W. & H. B. Taylor, 31, Crutched Friars, E.C., solicitors for the petitioners, on payment of the regulated charge for the same. Any person who intends to appear on the hearing of the said petition must serve on or send by post to the above-named, notice in writing of his intention so to do.

Walsall and Electric Lighting.—At the meeting of the Walsall Town Council last Monday, the General Purposes Committee recommended the approval of a report from the Electric Lighting Sub-committee, and that the Council apply to the Board of Trade for their approval of the adoption of a system of electric lighting for the borough on the principle suggested in such report, viz.: High-tension, with transformers; and also apply to the Local Government Board for their sanction to a loan of £19,650, in addition to the estimated value of the suggested site at the Wolverhampton Street Gas Works, for the cost of carrying out the proposed scheme; and that the Council enter into contracts with the Electric Construction Company, Limited, for the electrical plant for the sum of £10,003; with Messrs. Bumstead & Chandler for the engines for the sum of £1,350; and with Messrs. H. & T. Danks for the boilers for the sum of £805, as soon as the approval of the Board of Trade and the sanction of the Local Government Board is received.

Richmond Electric Lighting.—What is said to be the largest installation carried out in Richmond, up to the present, is that of Messrs. Williamson & Sons, of George Street, consisting of 55 32-C.P. lamps prettily arranged, in three rows, the whole length of the shop inside, and nine groups of 3 32-C.P. lamps in windows and outside. This installation was carried out by the local firm of Messrs. Harrison, Coles & Co., who have also completed Messrs. Wenton & Co.'s drug stores; Mr. H. Morris, baker and confectioner; Mr. F. Hampton, baker and confectioner; Mr. E. Ripleys, naturalist; Mr. Chas. Capel, smith, of Belle Vue Lodge; and several others. Messrs. Harrison, Coles & Co. have also taken over the business lately carried on by Mr. Arthur Browne, at 20, Kensington Court Place. They are also laying down new plant at Hermitage Works, Richmond, owing to the increase of business in connection with the lighting department.

The Taunton Electric Lighting Company, Limited.—At an extraordinary general meeting of the above company, held at 12, Hammet Street, Taunton, on November 9th, the following special resolution was duly passed, and at a subsequent extraordinary general meeting was duly confirmed: "That the company be wound up voluntarily; and that Albert Goodman, of Taunton, chartered accountant, and William James Villar, of Taunton, auctioneer, be appointed liquidators of the company." The creditors of the above company are required, on or before January 5th, 1894, to send their names and addresses, and the particulars of their debts or claims, to Albert Goodman, chartered accountant, Taunton, and William James Villar, auctioneer, Taunton, the liquidators of the said company, or to Kite & Broomhead, 12, Hammet Street, Taunton, solicitors for the liquidators.

Dublin Electric Lighting.—The accounts of the Electric Lighting Committee shows that the excess of income over expenditure for the current year, together with an increased estimate for income for the year 1894, resulted in the appearance of an estimated surplus on foot of this account, for the year to end December 31st, 1894, of £1,129 6s. 5d., and there was therefore no provision out of rate necessary for the maintenance of this department for the coming year. There was an estimated increase of expenditure as compared with the amount expended this year of about £3,000, but this was covered by the savings shown in the appendix, which amount to £3,219 1s. 1d. of which £2,565 1s. 11d. is excess of estimated income over estimated expenditure for 1893.

Swansea Tramways.—Mr. Manville, who has been advising the Corporation on the electric lighting question, also recommends the utilisation of electric power for the propulsion of tramcars. A Cardiff daily speaks of "electricity and tramcar running" as "a novel suggestion," in a manner which gives one the idea that the editor has never heard of such before. "The electric lighting committee of the Corporation are considering this novel suggestion." While our Cardiff contemporary is so far behind the times, a Sheffield daily on the same day shows itself well up in matters by saying that "electric trams and electric railways are quite recognised institutions in this country."

Edinburgh Electric Lighting—Proposed Extension.—The Town Council have decided when uplifting the streets for placing electric wires for public lighting, to instruct the Lord Provost's Committee to have the wires placed in streets so that houses, shops, and premises may be able to secure a supply of electric light without the necessity of again uplifting the streets. Two members gave notice of motion that it be remitted to the Lord Provost's Committee to consider and report on the advisability of extending the electric lighting to that portion of the High Street from the Tron Church to Jeffrey Street.

Personal.—We understand that Mr. B. H. Jenkinson, who has just completed the lighting of the Southampton Docks is leaving to take charge, on behalf of Messrs. Crompton & Co., of the works in progress at the G.E. Railway Company, at Liverpool Street, Bishopsgate, and Spitalfields.

Mr. W. J. Furse, who for the past 12 years has managed the business of Mr. Joseph Blackburn, of Nottingham, has resigned his position and bought the business of the late Mr. Josiah Till, electrician of the same town, and will continue it on his own account.

Electric Lighting in Dublin.—In the House of Commons on Monday, Mr. Henniker Heaton, on behalf of Mr. Carson, asked whether the Postmaster-General had entered into agreement with the Municipal Corporation of Dublin for the supply by them of the electric light to the General Post Office, Dublin. Mr. A. Morley: No proposal is under consideration for lighting the General Post Office in Dublin with electric light; perhaps the question refers to the new parcels sorting office, where the Board of Public Works are proposing to provide electric light.

Electric Lighting of Dunfermline Works.—During the last few weeks a complete installation of electric light has been in progress at Messrs. A. E. Walker, Reid & Co.'s Albany Works, Dunfermline. The installation and erection of plant have been entrusted to Messrs. J. H. Holmes & Co., of Newcastle-on-Tyne. The generating plant consists of two drum bar armatures of the latest type. The larger of the two has an output of 580 ampères at an electrical pressure of 115 volts—that is, capable of supplying 1,191 16-candle-power lamps. This machine is driven by the main mill engine from a counter-shaft at the low speed of 420 revolutions per minute. The smaller machine gives 300 ampères at 115 volts, or 616 16-candle-power lamps. This is driven by a special 50-brake horse-power vertical engine running at a speed of 230 revolutions per minute, and with a cylinder of 10½ inches diameter, and a 10-inch stroke. The total number of lamps installed in the works is 1,500.

Telephone Exchange for the Isle of Wight.—The Mayor of Newport (Mr. F. Pittis) presided on Friday at a meeting which was held to consider the desirability of establishing a telephone exchange in the island. Mr. Clay, of the National Telephone Company, explained the system, and a representative committee was formed to further the movement. Mr. Clay stated that if 100 subscribers were found they would afford communication between Newport, Ryde, Sandown, Shanklin, Ventor, Cowes, and Freshwater.

Bray Electric Lighting.—At a recent meeting of the Township Commissioners, a letter was read from Mr. Harris (liquidator of Messrs. J. E. H. Gordon & Co.), offering to dispose of his client's interest in Bray works to the commissioners. The lighting inspector reported that the lights were short on several nights during the past fortnight. After a protracted discussion, both matters were referred to a special committee of the whole house for investigation and report by next meeting.

Elmore French Copper Company.—In a letter to the *Financial News*, Messrs. Maddisons say: "May we also mention that although our client, Mr. Duncan, who is receiver for the debenture-holders, was asked to accept the office of liquidator, and was willing to do so as soon as the sale in France was actually completed, the appointment was deferred to the 20th inst.? By that date we hope to have received the obligations and founders' shares. We have already received the cash."

Apprentice and Employer.—At the Derby Police Court last week, Alfred Henry Hunter, an apprentice, was summoned for absenting himself from the employ of his master, Samuel Rowbottom, electrical engineer, on November 30th and two following days. After hearing the evidence the Bench expressed the opinion that there was fault on both sides, and the case was adjourned for a month. The lad, who has returned to work, complained that he had been sworn at.

Grimsby Electric Lighting.—Grimsby Corporation Lighting Committee last week, considered and approved the Provisional Order being applied for by them. The Mayor, in the course of the discussion, expressed the hope that if they found the electric light would be advantageous, they would, before two years had expired, be supplying it to the town. Many of the shop-keepers have expressed a desire to have it in their premises.

Provisional Order Revoked.—The *London Gazette* contains a notice by the Board of Trade that they have revoked the House-to-House Electric Light Supply Order, 1889, as confirmed by the Electric Lighting Orders Confirmation (No. 3) Act, 1889, in so far as it relates to the area of supply specified in paragraph (*b*) of the first schedule to the order, as from December, 1893, and that the said revocation is to take effect from such date.

The Thames Iron Works and Ship Building Company.—This company have acquired the sole right of manufacture for the United Kingdom, of Mr. F. J. Rowan's electric-magnetic drilling, riveting, and caulking machines, which we believe have already met with much favour among ship-builders and bridge-builders. In portability and convenience of handling, these machines are said to be much superior to hydraulic tools.

G. Braulik.—Mr. Braulik shows a determination not to let the grass grow under his feet, and is already issuing his 1894 catalogue of electrical supplies including bells, telephones, medical apparatus, electric light plant, and accessories of all kinds. As the publication contains, at least, a thousand illustrations, all of which represent items that are described and priced, it will be found useful and handy for reference.

Winchester Electric Lighting.—On the recommendation of the electric lighting committee the Winchester Town Council have authorised an expenditure of £50 for a canvass, with a view of ascertaining the number of persons or institutions within the area described in the schedule, who would be willing to use the electric light, and the number of lights they would require.

Leeds Smithfield Show Electric Lighting.—The avenue at this show was illuminated by means of six arc lamps. The approach to the show from Camp Road was also lighted by arc lights, the power being obtained from a gas-engine which was erected for the purpose. The electric light installation was fitted by Mr. F. W. Dickinson, of Leeds.

Electric Light at Hackney.—Messrs. Ball Bros. & Bates, of Holborn, have just completed an electric lighting installation at the printing works of Messrs. Roberts, Son & Co., of Hackney. The plant consists of a Crompton dynamo driven by a Tangye horizontal engine of 8 H.P. Glow lamps have been installed in the offices and works throughout.

The Electric Light at Bristol.—The Bristol City Council, on Tuesday, considered a recommendation from the electric lighting committee to borrow an additional £24,000. In 1891 the Council authorised the borrowing of £66,000, but the liabilities already incurred reach £79,920. The cost of the building was originally put down at £5,000, whereas it has amounted to £24,600. Of this, £15,873 may be regarded as the cost of extra work—piling, erecting a river wall, &c. After a lengthy discussion the recommendation was agreed to.

Margate and Electric Lighting.—The Town Council have decided "That the applications with respect to electric lighting, and for the consent of the Corporation to construct and work a tramway in the borough be not entertained, as the time is too limited to admit of a proper consideration of these matters."

Southport Electric Lighting.—The Town Council Lighting Committee have approved the new specifications for high tension mains prepared by the engineer, and instructed the town clerk to invite tenders from the firms who tendered to the old specification.

Chapel Electric Lighting.—Broadmead Chapel, Bristol, was brilliantly illuminated by electricity last week. This is said to be the first place of worship in Bristol in which the new illuminant has been used. The installation has been successfully carried out by Messrs. J. S. Willway & Sons.

Purification of Sewage by Electricity.—The Worcester authorities have resolved to request the surveyor to confer with Mr. C. Hawksley, with the view of deciding the extent to which electricity can be utilised for pumping or purifying the sewage.

Southampton Electric Cranes.—On the 7th inst. further trials were made with the two electric cranes on the Southampton Town Quay, the results being considered very satisfactory.

Ashover and the Electric Light.—The directors of the Ashover Hydropathic Establishment have under consideration the question of introducing the electric light into the establishment.

Theft of Telephone Wire.—Wm. Bowden was last week sentenced to 21 days imprisonment for stealing 15s. worth of telephone cable from the National Telephone Company, at Bristol.

Change of Address.—Messrs. J. H. Tucker & Co., owing to the rapid increase of business, have removed their works to larger and more convenient premises at 10, Ryland Street, Birmingham.

Ship Lighting.—The tender of Messrs. Allen & Co., electrical engineers, has been accepted for supplying electric lighting machinery for the cruiser *Talbot*, to be built at Devonport.

Electrical Exhibition.—At a bazaar held at St. Andrew's Church, Montpelier (Bristol), an exhibition of electrical appliances was lent by Messrs. King, Mendham & Co.

Electricians at Dinner.—The employés of the Birmingham Electric Supply Company, Limited, held their annual dinner at the Colonnade Hotel on Friday last.

Electric Lighting at Dursley.—The electric light has just been installed at The Towers, Dursley, the new residence of Mr. R. A. Lister, J.P.

Woodhouse and Rawson United.—The first meeting of creditors is to be held at Cannon Street Hotel on December 21st at 2 p.m.

Calendars, &c.—The Direct United States Cable Company, Limited, have sent us a useful calendar for 1894.

CITY NOTES.

The Medical Battery Company, Limited.

UNDER the winding-up order recently made against this company the first meeting of creditors was held last Friday at the Holborn Restaurant, under the presidency of Mr. Warley, Assistant Official Receiver. The directors in attendance were Mr. C. B. Harness, Mr. Graff, and Major Elers.

The CHAIRMAN reported that 142 proofs had been lodged for sums amounting to £15,835. Proxies had been sent in to the extent of only about £1,600. The statement of affairs was lodged on the 6th inst., consequently sufficient time had not elapsed to allow the Official Receiver's observations to be framed and sent out to the creditors in the usual way. A draft had been prepared, however, and it would doubtless be convenient to state to the meeting the heads of the case. The statement showed unsecured creditors, £15,766 16s. 3d., preferential claims, £106, and loans on debenture bonds, £8,150. The value of the securities held by the debenture holders was the gross amount of the assets, viz., £4,242; consequently there was a margin of £3,908 to be added to the unsecured debts, making the total ranking amount of liabilities, £19,780 16s. 3d. The assets which had been taken possession of by Mr. A. J. Davis, the receiver appointed on behalf of the debenture holders, included the following items, viz.:—Cash at bankers, £571; cash in hand, £21; stock-in-trade, estimated to have cost £6,058, and now expected to produce only £500. The meeting was doubtless aware of the special nature of the stock, and that it was under the circumstances very difficult to place any real value on it. Other items were:—Machinery, expected to produce £1,000; trade fixtures, fittings, and furniture, £1,000; leasehold premises, £1,000; good book debts, £48; and doubtful debts for £530, returned at £100. The winding-up order was made in the High Court on November 22nd, upon a creditor's petition presented in October. After referring to the origin of the company, which was incorporated on May 6th, 1889, to purchase the business of a previously existing company of the same name, he said the original directors were Mr. and Mrs. Harness and Mr. L. Graff. Mrs. Harness resigned in March, 1893, and Mr. D. G. Macrae, who was appointed in her place, resigned in the following October. Miss A. Smith was appointed in June, 1893, and resigned in the following October, and Major C. G. Elers was appointed on June 9th last. The secretary of the company was Mr. H. C. R. Sharman, who resigned last July, and a week later Mr. J. H. Hodges was appointed in his place. The most important duties ordinarily performed by a company secretary had apparently been fulfilled by Miss A. Smith, who was nominally bookkeeper and chief cashier. The solicitor of the company was Mr. A. Fleet. The operations of the company were extended in various ways from time to time. Branch offices were opened in Liverpool and Leeds, and very large sums were spent in advertising the electrical and medical appliances of the company, and its methods of treating disease. Other premises were added, and the receipts increased until the beginning of the present year, when articles appeared in two papers, commenting unfavourably upon the conduct of the company's business. In the litigation which ensued, the company was unsuccessful, and was put to great expense, and, moreover, the receipts immediately decreased. It therefore became necessary to realise certain investments (which had been made by way of reserve) to the extent of £4,000. In March, 1893, it was resolved to issue debentures for £10,000, of which £6,000 was offered to the shareholders, who, however, at first made but small response to the offer. The total issue was £8,150, of which Mr. Harness held £3,000, and Mr. Graff £1,000. Miss A. Smith held by transfer from Mr. Harness £1,500, it was alleged in trust to provide for certain personal liabilities undertaken by him on the company's behalf, and debentures for £500 were issued to Mr. Fleet in discharge of his claim for costs as solicitor. On October 14th last it was resolved to increase the capital of the company to £200,000, by the issue of 20,000 preference shares of £5 each. A prospectus was accordingly issued, and articles appeared in a certain London evening paper strongly animadverting upon the company and Mr. Harness. The advertisement of the prospectus was at once withdrawn, and the money received on application for the preference shares was returned. On November 3rd it was decided to wind up the company, and that Mr. A. J. Davis should be the voluntary liquidator, that gentleman having, on October 28th, taken possession of the company's premises and assets as receiver for the debenture holders under an order of the Court. The salary of £1,000 per annum to Mr. Harness, the president and managing director, was, at a general meeting of the shareholders held in January, 1891, increased to £2,000 per annum. The dividends paid were as follows, namely, £4,500 in 1889, and £10,000 during each of the three following years; whilst the directors' fees during the same period amounted to £1,650. The present unsecured debts included £13,867 for advertising and printing, and £1,879 for goods supplied. The estimate of the company's assets was based upon the supposition that the realisation would take place at once by public sale, but it was asserted that in the hands of a company carrying on the same or a similar business their value would be very much greater. The largest shareholders in the company were Mrs. Harness, £38,205; Mr. Harness, £7,225; Major Elers, £14,205; Mrs. Elers, £5,250; and Mr. M'Rae, £5,000. The deficiency account showed an excess of assets over capital and liabilities at May 1st, 1889, of £2,525 14s. 3d.; gross profit from business during the company's existence, £274,260; and a present deficiency of £119,780. Those figures make a total amount of £396,567, which was accounted for by the following items, viz., salaries and wages, £41,457; rent, rates, and taxes, £7,260; miscellaneous trade expenses, £188,964; depreciation written off on the company's books, £2,647; interest on loans, £337; bad debts, £430; directors' fees, £1,650; dividends, £34,500; losses on investments, £198; depreciation on property not written off in the company's books, £111,671; law costs, £6,588; and experiments, £861. The salaries and wages included the salary to the managing director as well as those of the four doctors employed by the company. The expenses of advertising were included in the miscellaneous trade expenditure, and were as follows, viz., 1889, £15,862; 1890, £26,610; 1891, £42,074; 1892, £49,797; and 1893, £36,535, making a total of £170,880. A committee of creditors appointed recently had prepared a report which would be read to the meeting.

Mr. LYLE, the chairman of such committee, said they had instructed Mr. Rogers, of the firm of Rogers & Co., solicitors, Walbrook, to arrange for counsel to watch the legal proceedings on their behalf, and as Mr. Rogers was then present he would read the report that had been prepared.

Mr. ROGERS thereupon read the report, from which it appeared that the committee, failing the removal of Mr. Davis as liquidator, agreed to support the petition for winding up the company under a compulsory order.

Mr. HARNESS next addressed the meeting, and commented upon the statement of the Official Receiver. He first explained that the landlord of the premises refused to grant a lease to the Medical Battery Company, but granted one to him personally, and, as he had to take upon his shoulders the liability, he was justified in making the small profit rental of £250 per annum. He next dealt with the value of the assets, and said that if the creditors and debenture-holders could only come to terms the aspect would be very different from that disclosed by the statement of affairs. After some further explanations, he said the company had been "hounded down" by the

ELECTRICAL REVIEW and an evening paper, whose name he declined to advertise at that meeting. (Laughter.) He justified the largeness of the capital by the fact that they knew they had a very valuable process for the treatment of diseases by electricity, and, although they had only a cash capital of £10,000, they were justified in taking £90,000 as the value of the goodwill at the formation of the company. Mr. Harness then explained the reason for raising the money on debentures, and entered at some length into the views of the company with regard to the various libel actions which had been instituted. He regretted they had not taken the cases to the Court of Appeal, and expressed his intention to fight the matter out to the bitter end, now that he had been brought to a fighting humour. On behalf of the company, he had endorsed several acceptances, and was given debentures as collateral security. The desire of the debenture-holders was to pay 20s. in the pound, and if a practical committee were appointed he would be pleased to work upon it and do all in his power to assist matters.

A resolution for the appointment of the Official Receiver as liquidator was afterwards put to the meeting and carried unanimously.

A committee of inspection was also appointed, consisting of four creditors and three shareholders. The creditors selected were Messrs. Poulter, Lindley, Greenberg and Lyle, who had acted on the committee of creditors before referred to.

At the meeting of shareholders, held later in the day at Carey Street, W.C., Mr. Warley again presided, and, having reported upon the course pursued by the creditors, he invited a resolution from the meeting. It was unanimously agreed for the Official Receiver to act as liquidator, and Mr. C. B. Harness, Major Elers, and Mr. Fleet were selected to act on the committee of inspection in the interests of the shareholders.

The General Electric Power and Traction Company, Limited.

THE directors' report, submitted to the shareholders at the third ordinary general meeting, held at Winchester House on December 12th, 1893, reads as follows:—

"The directors beg to submit the balance-sheet and profit and loss account for the year ended September 30th, 1893. At the last annual meeting the shareholders were informed that arrangements had been made with the Electric Construction Company, Limited, by which that company undertook the management of the affairs of this company. The directors have pleasure in stating that this arrangement has worked very satisfactorily, and the following comparative figures indicate the economies which have been effected in the management. The trading accounts for the past year show a profit on the manufacturing department of £1,010 12s., and a profit on launch department of £31 14s. 2d., whereas for the previous year the accounts showed losses of £3,121 14s. 2d. and £570 10s. 3d. respectively. Furthermore, the expenses of management, exclusive of directors' fees, have been reduced from £3,727 15s. 5d. in 1892, to £556 17s. 2d. in the past year. The directors have decided to cancel the amount of £862 10s. standing to their credit at the end of September, 1892, and have debited the past year with only £186 18s. in respect of remuneration. Statement No. 1 gives details of the year's transactions. During the past year the directors have determined sundry unprofitable transactions by sales and closing of leases, and have made provision for possible depreciation on such of the dismantled plant as is still unsold. These items are set out in Statement No. 2. The accounts, however, do not deal with the larger question raised by the auditors in their report of January last, whether the book value of patents and goodwill should be further reduced. The directors regard it desirable that the capital should be brought into conformity with the real position of affairs, and they are giving this matter their further consideration with a view to a reorganisation of the company. The question of removing the manufacturing works referred to in the last report has received the anxious consideration of the directors, and, with the assistance of the new management, they hope to overcome this difficulty in a way which offers many advantages over the original plan of removing the works to Millwall. An agreement has been made, subject to the approval of the shareholders, for an amalgamation with the Acme Electric Works at Kentish Town. This arrangement has the merit of providing suitable manufacturing works already equipped at a smaller annual cost for rent and other standing charges than at present incurred by the company, and avoids the heavy cost of removing machinery to a distance, and the serious disorganisation of the current business which this would involve. The copper depositing works at Millwall are now completed, and the question of providing the necessary capital for commencing operations is receiving the consideration of the directors. In accordance with the articles of association, Mr. Moritz Immisch and Mr. James Pender retire by rotation, and offer themselves for re-election. The auditors, Messrs. Ward and Wilding, also retire, and offer themselves for re-election.

STATEMENT No. 1.—PROFIT AND LOSS ACCOUNT.

Showing transactions of the year ended September 30th, 1893.

TRADING ACCOUNT.—Manufacturing Department.

DR.	£	s.	d.
To Salaries and commission	621	4	2
„ Rent, rates, taxes, fire insurance, gas, &c.	711	11	10
„ Advertising, printing, postages, stationery, carriage and general trade expenses	905	0	4
„ Balance, being profit carried down	1,010	12	0
	£3,248	8	4

CR.	£	s.	d.
By Gross profit on manufacturing account	3,248	8	4
	£3,248	8	4

TRADING ACCOUNT.—Launch Department.

DR.	£	s.	d.
To Wages of men, salaries of staffs, and captains of boats	1,494	18	0
„ Coal and coke	204	8	7
„ Advertising	250	1	4
„ Sundry trade expenses	136	5	2
„ Travelling expenses, &c.	95	0	7
„ Printing, postages, &c.	96	4	10
„ Rent, rates, taxes, and fire insurance...	223	18	2
„ Lock dues, survey and registration fees	144	10	9
„ Balance, being profit carried down	31	14	2
	£2,677	1	7

CR	£	s.	d.
By Hires, charging, and profit on sale of boat	2,677	1	7
	£2,677	1	7

GENERAL PROFIT AND LOSS ACCOUNT.

	£	s.	d.
To Directors' fees	186	18	0
„ Rent	176	15	1
„ Management expenses	556	17	2
„ General expenses, printing, &c.	207	10	11
„ Maintenance of patents	39	3	10
„ „ of plant and launches	554	3	1
	£1,721	8	1

	£	s.	d.
By Manufacturing department, profit as above	1,010	12	0
„ Launch department, profit as above	31	14	2
„ Transfer fees	0	16	0
„ Loss transferred to balance-sheet	678	5	11
	£1,721	8	1

STATEMENT No. II.—PROFIT AND LOSS ACCOUNT No. 2.

Showing liquidation of old transactions.

	£	s.	d.
Depreciation of plant at Barking, Chertsey, Kentish Town, and of launches on Lake Windermere and Manchester Ship Canal	5,784	7	3
Expenses connected with up-keep of Barking, Windermere, and Manchester plants, including sums paid for determining leases at Windermere, and removal of Barking plant	572	4	6
Expenditure and book items written off relating to liabilities incurred in former years, and settled or compromised during this year	1,308	12	10
Debtors considered good last year written off	602	7	6
Reserve against bad and doubtful debts of previous years	451	0	0
	£8,718	12	1

	£	s.	d.
By Amount standing at credit of directors in last balance-sheet, cancelled	862	10	0
„ Loss, carried to balance-sheet	7,856	2	1
	£8,718	12	1

STATEMENT No. III.—BALANCE SHEET, September 30th, 1893.

LIABILITIES.

	£	s.	d.
Authorised capital—25,000 ordinary shares of £10 each, £250,000; 10,000 preference shares of £10 each, £100,000	350,000	0	0
Issued capital—23,592 ordinary shares fully paid, £235,920; 10,000 preference shares £9 called up, £90,000; plus calls paid in advance, £156; less calls in arrear, £674	325,402	0	0
Sundry creditors	7,792	15	5
Reserve for discount and bad and doubtful debts ...	451	0	0
	£333,645	15	5

ASSETS.

	£ s. d.
Capital expenditure — As per last balance-sheet, £219,264 12s. 4d.; balance of purchase of copper-depositing patent, subject to contingent claim, £10,000; further expenditure on copper-depositing works and purchase of plant and new launch built, £14,304 13s. 8d. = £243,569 6s.; less depreciation, £5,784 7s. 3d.; less sale of plant, £350	237,434 18 9
Stock on hand	14,469 11 11
Sundry debtors	4,716 0 10
Cash at banks and on hand	191 15 11
Profit and Loss account, as per last balance-sheet, £68,299; add balance of Profit and Loss account, per Statement No. 1, £678 5s 11d.; add expenditure connected with liquidation of previous years' transactions, as per Statement No. II., £7,856 2s. 1d.	76,833 8 0
	£333,645 15 5

We have examined the above balance-sheet with the books of the company, and certify the same to be in accordance therewith, and correct subject to our report, and the completion of the audit.

December 9th, 1893. WARD & WILDING, *Chartered Accountants.*

At the meeting of the company, held at Winchester House, on Tuesday, Lord Egerton of Tatton presided, in the absence, through indisposition, of the Earl of Albemarle, K.C.M.G.

In moving the adoption of the report and accounts, the CHAIRMAN said the general depression of trade still affected the company, and the four businesses, which in the first instance were thought to have a good prospect of development, had not succeeded in the manner expected. With regard to the electric traction business, the success at the works at Barking had not, in consequence of the indisposition of municipal authorities to undertake electric traction, been such as to enable them to carry on that work. A slight profit had been derived from the launches, but the directors thought the efforts of the company should be concentrated on the manufacturing and copper-depositing businesses. The manufacturing business showed a profit of £1,010, but there was a loss on the general balance-sheet. It was proposed to amalgamate the Kentish Town works of the company with the Acme Electric Works, on the basis of the relative value of the two works. For that purpose a new company would be formed, in which this company would have five-eighths interest and the Acme Company three-eighths. The capital was proposed to be £25,000, of which £5,000 would be issued as preference shares for the purpose of working capital. As to the general position of the company, it was quite evident that under the present circumstances the capital was not fully represented by the assets, and already there was a debit balance of £76,000. There must, it was clear, be some reorganisation, and that deficit be written off, before any dividends could be paid. The board hoped shortly to submit a proposal to the shareholders.

The motion was seconded by Mr. MORITZ IMMISCH, and carried, and the agreement with the Acme Company was also approved, it being stated that the security of the preference shareholders would be fully maintained.

Dover Electricity Supply Company.

WITH a capital of £50,000, in £5 shares, this company has been formed for the purpose of supplying electricity in Dover Borough. The corporation have arranged with the company to supply current to public lamps to be installed in a number of the principal thoroughfares. At present the arrangement is to erect and run 21 arc lamps for £650 per annum, for a term of 21 years, with power to either party to determine the same at the end of the seventh or fourteenth year by 12 months' notice. A contract has been entered into with the Brush Company for the supply and erection of the generating equipment, and for the laying of the necessary mains, sufficient for 10,000 8-C.P. glow lamps for private lighting, and 25 arc lamps of 2,000 C.P. for public lighting, for the sum of £25,000. The condition of the contract has been the matter of report by Mr. Gisbert Kapp. 7,000 £5 shares are at present offered for subscription. The Brush Company have undertaken that 3,000 of these shares shall be subscribed. The company should have a good future before it, and we feel sure Dover inhabitants will readily subscribe. The mayor of the town (Sir William Crundall) is chairman of the company, and the directors are:—C. W. Bagshawe, B. H. Van Tromp, and R. Percy Sellon. The engineer and manager is Mr. A. J. Lawson, and Mr. B. Broadhurst is secretary. The list opened on Monday last, and closes to-morrow, 16th inst. The office is situated at 49, Queen Victoria Street, E.C.

Hove Electric Lighting Company.

THE first annual general meeting of the Hove Electric Lighting Company was held on Tuesday afternoon in Hove Town Hall, Col. A. J. Filgate, R.E., presiding.

The CHAIRMAN, in moving the adoption of the report, said he understood that the Hove Commissioners were about to extend the light to the Town Hall, and he hoped that the lighting of some part of the town with arc lamps would soon be put in hand. After tracing the progress of the undertaking, he said that although he could not yet class the shares of the Hove Electric Lighting Company as a "gilt-edged" security, he believed it to be a thoroughly sound enterprise, and one likely to pay good dividends. He expressed satisfaction in regard to the excellent manner in which the works had been carried out by Messrs. Crompton & Co. and their staff.

Mr. CARLETON E. TUFNELL seconded the motion for the adoption of the report.

Mr. G. B. WOODRUFF, J.P., chairman of the Hove Commissioners, speaking on behalf of that body, expressed satisfaction with the manner in which the company had carried out the contract it entered into with the Commissioners, and wished the undertaking every success. The resolution was carried.

The Exploration Company.

THE directors' report for the "twenty-three months ended November, 1893," contains the following paragraph:—"The Central London Railway Act, 1892, which authorised the extension of the line to Liverpool Street and the construction of an underground station and a system of public subways at the Royal Exchange, received the Royal Assent on June 28th, 1892. The formal approval of the Commissioners of Sewers of the City of London to the plans of the station and subways was obtained in June, 1893. All necessary Parliamentary and other powers for the carrying out of this most important enterprise have now been obtained, but it has been considered judicious, in view of the unfavourable state of the money market, to defer the issue of the capital. In the meantime, as a measure of precaution, notice has been given of an application to Parliament to extend the time during which the compulsory powers of the company can be exercised."

Venezuela Telephone and Electrical Appliance Company, Limited.

MESSRS. E. D. OPPERT & Co. are offering for sale £50,000 of 5 per cent, first mortgage debentures of £100 each, at the price of £87½ per cent., repayable at par on October 1st, 1910, or at the company's option any time after July 1st, 1895, at £105, upon six months' notice of redemption. The prospectus states that these debentures are a first charge upon the whole property of the company, which was established in 1890 to take over the undertaking and business (then already in full working), under the concession granted by the Government of Venezuela. The net revenue has at all times considerably exceeded the requirements for the service of the whole of the first mortgage debentures, and the profit and loss account for the year ended June 30th, 1893, shows a gross income of £18,444, against operating expenses, maintenance of lines, general charges, &c., £12,579, including some exceptional amounts not likely to recur, leaving a surplus for interest on debentures, London and other minor expenses, of over £5,800.

The Swan United Electric Light Company, Limited.—The accounts of this company for the year ending September 30th, 1893, came before the directors on Tuesday, and, subject to audit, they resolved to recommend the shareholders to declare a dividend as follows:—3s. 6d. per share on the 78,949 ordinary shares of the company, £3 10s. paid; and 4s. 3d. per share on the 19,750 £5 fully paid shares, free of income tax. This, together with the interim dividend paid on June 20th last, makes a total distribution of 7½ per cent. for the year on the ordinary £3 10s. paid shares of the company. The dividend will be paid upon the register as it stood on 12th inst., and the warrants will be issued on the 23rd inst.

National Telephone Company, Limited.—The directors have declared interim dividends for the half-year ending October 31st, 1893, as follows:—On first and second preference shares at the rate of 6 per cent. per annum, less income-tax, and on third preference and ordinary shares at the rate of 5 per cent. per annum, less income-tax.

Commercial Cable Company.—This company has determined to redeem on January 15th next the whole of the outstanding mortgage debentures of the company, being 800 debentures of £100 each, and notifies that the principal sums will be payable at the offices, 12, Queen Anne's Gate, S.W., of Messrs. Siemens Bros. & Co., Limited.

Stock Exchange Announcements.—The Stock Exchange Committee have ordered the under-mentioned securities to be quoted in the Official List:—Electric Construction Company, Limited—12,845 7 per cent. cumulative preference shares, Nos. 1 to 12,845; 120,000 ordinary shares, Nos. 1 to 120,000.

Electric Construction Company.—At a meeting held at the offices, Queen Street Chambers, Queen Street, E.C., last Friday, the resolutions passed on the 16th ult., altering the articles of association, were confirmed.

Eastern Extension, Australasia and China Telegraph.—An interim dividend has been declared for the quarter ended September 30th of 2s. 6d. per share.

TRAFFIC RECEIPTS.

The City and South London Railway Company. The receipts for the week ending December 10th, 1893, amounted to £911; week ending December 11th, 1892, £933; decrease, £22; total receipts for half-year, 1893, £19,132 corresponding period, 1892, £18,976; increase, £156.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending December 8th, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £3,453.

SHARE LIST OF ELECTRICAL COMPANIES.

Present Issue.	Name.	Stock or Share.‡	Closing Quotation December 6th.	Closing Quotation, December 13th.	Business done during week ended December 13th, 1893. Highest.	Lowest.
184,500£	African Direct Telegraph, Ltd., 4 p. c., Deb. Regd. and to Bearer	100	100 —103	101—104	101½	...
1,134,640£	Anglo-American Telegraph, Limited	Stock	43 — 45	42 — 45	44	...
2,932,680£	Do. do. 6 p. c. Preferred	Stock	82 — 83	81 — 82	83⅜	81⅝
2,932,680£	Do. do. Deferred	Stock	7½ — 8	7½ — 8	8	7⅞
130,000	Brazilian Submarine Telegraph, Limited	10	11⅜ — 12½	11⅜ — 12½	12⅛	...
18,700£	Do. do. 5 p. c. Bonds	100	100 —103	101 —104	...	...
75,000£	Do. do. 5 p. c., 2nd Series, repayable in June, 1906 ...	100	107 —111	108 —112	109½	...
77,978	Brush Electrical Engineering Ordinary, Nos. 1 to 63,416	3	2⅝ — 2⅞	2⅝ — 2⅞	2¹⅛	2⅝
75,000	Do. do. Non cum. 6 p. c. Preference, Nos. 1 to 63,416	2	2⅛ — 2⅜	2⅛ — 2⅜	2⅛	2³/₁₆
125,000£	Do. do. 4½ per cent. Debenture Stock	Stock	105 —107	105 —107	105	...
20,510	Charing Cross & Strand Electricity Supply Nos. 1 to 6, 215 to 718, and 10,001 to 30,000	5	4⅜— 5⅛	4½— 5	...	...
44,000	Chili Telephone, Limited, Nos. 1 to 40,000	5	2 — 3	2 — 3	...	...
630,000£	City and South London Railway	Stock	28 — 33	28 — 33	...	...
40,000	City of London Elec. Lighting Co., Ltd., Ord. 40,001-80,000 ...	10	11½—11⅝	11½— 11⅝	11⅝	...
20,000	Do. do. 6 p. c. Cum. Pref., Nos. 1 to 20,000	10	12⅜— 13½	12⅜— 13½	13½	13¹/₁₆
10,000,000$	Commercial Cable, Capital Stock	$100	140 —150	140 —150	...	...
224,850	Consolidated Telephone Construction and Maintenance, Limited ...	10/-	1/16— 3/16	1/16— 3/16	...	...
20,000	Crompton & Co., Ltd, 7 p. c. Cum. Pref. Shares, Nos. 1 to 20,000	5	4 — 4½	4 — 4½	...	...
50,000£	Do. do. 5 p. c. 1st Mort. Debs., 1—400 of £100, and "A" 1—200 of £50 each	...	96 —101	96 —101	...	...
16,000	Cuba Telegraph, Limited	10	11½ — 12½	11½ — 12½	...	...
6,000	Do. do. 10 p. c. Preference	10	18 — 19	18 — 19	...	...
12,931	Direct Spanish Telegraph, Limited, ... (£4 only paid)	5	2½ — 3½	2½ — 3½	...	...
6,000	Do. do. 10 p. c. Preference	5	8½ — 9½	8½ — 9½	...	...
60,710	Direct United States Cable, Limited, 1877	20	11⅛ — 11⅜	11⅛ — 11⅜	11⅜	11⅛
400,000	Eastern Telegraph, Limited, Nos. 1 to 400,000	10	14⅜ — 15⅛	15 — 15⅛	15⅛	14⅞
70,000	Do. 6 p. c. Preference	10	15½ — 16½	15½ — 16½	15⅝	15⅜
105,900£	Do. 5 p. c. Debs. (1879 issue), repay. August, 1899	100	108 —111	108 —111	...	...
1,294,100£	Do. 4 p. c. Mortgage Debenture Stock	Stock	114 —117	114 —117	116½	115
250,000	Eastern Extension, Australasia and China Telegraph, Limited ...	10	15⅜— 15⅝	15½— 15⅝	15¹/₁₆	15½
62,700£	Do. 5 p. c. (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326	100	102 —105	103 —106	...	...
222,800£	Do. do. Bearer Nos. 1050—3,975 and 4,327—6,400 ...	100	102 —105	103 —106	...	...
320,000£	Do. 4 p. c. Debenture Stock	Stock	114 —117	114 —117	117	116
108,700£	Eastern and South African Telegraph, Ltd., 5 p. c. Mort. Deb. 1900 redeem. ann. drawings, Registered Nos. 1 to 2,343	100	102 —105	103 —106	...	...
146,800£	Do. do. do. to bearer, Nos. 2,344 to 5,500	...	102 —105	103 —106	...	...
300,000£	Do. do. 4 p. c. Mort. Debs. Nos. 1 to 2016, red. 1909	100	102 —105	103 —106	...	...
200,000£	Do. 4 p. c. Reg. Mt. Debs. (Mauritius Subsidy) 1 to 8,000	25	105 —108 %	106 —109 %	106⅜	...
120,000	Electric Construction, Limited, Nos. 101 to 45,100	£2	... ...	... ...	...	...
12,845	Do. do. 7 p. c. Cum. Pref., Nos. 1 to 12,845	2	... ...	... ...	...	...
19,900	*Electricity Supply Co. of Spain, Nos. 101 to 20,000	5	... ...	... ...	...	...
100,000	Elmore's French Patent Copper Depositing Co., Ltd, Nos. 1 to 66,750	2	... ...	... ...	...	...
91,195	Elmore's Patent Copper Depositing, Limited., Nos. 1 to 70,000 ...	2	⅛— ⅜	⅛— ⅜	...	...
67,385	Elmore's Wire Mfg., Ltd., Nos. 1 to 67,385, issued at 1 p.m., all pd.	2	0 — ¼	0 — ¼	...	...
20,000	Fowler-Waring Cables, Nos. 301 to 20,300 ... (£4 10s. only paid)	5	½— 1½	½— 1½	...	...
180,227	Globe Telegraph and Trust, Limited	10	8⅛— 8⅜	8⅛— 8⅜	8¹⅜	8⅛
180,042	Do. do. 6 p. c. Preference	10	15⅛ — 15⅜	15⅛ — 15⅜	15⅜	15⅛
150,000	Great Northern Tel. Company of Copenhagen	10	20 — 20½	20 — 20½	20⅜	...
200,000£	Do. do. 5 p. c. Debs. (issue of 1883) ...	100	103 —106	104 —107	...	...
12,134£	Greenwood and Batley, Ltd., Ordinary, Nos. 4667 to 14,000 ...	10	4½— 5½	4½— 5½	...	...
9,600£	Do. 7 p. c. Cumulative Preference, Nos. 2,667 to 8,000	10	6 — 7	6 — 7	...	...
50,000	India-Rubber, Gutta Percha and Telegraph Works, Limited ..	10	21½ — 22½	21½ — 22½	22½	21⅝
200,000£	Do. do. 4½ p. c., Deb., 1896	100	102 —104	102 —104	...	...
17,000	Indo-European Telegraph, Limited	25	40 — 43	40 — 43	...	...
11,334	International Okonite, Ltd., Ordinary Nos. 22,667 to 34,000	10	1 — 2	1 — 2	...	...
30,000	†Liverpool Electric Supply, £3 10s. paid	5	4½— 4⅝	4½— 4⅝	4⅞	4¹⅛
15,000	Do. do. fully paid	5	6½ — 6⅝	6½— 6⅝	6⅝	5⅝
37,500	Liverpool Overhead Railway Ordinary, fully paid	10	5½— 5⅝	5½— 5⅝	8½	4⅜
6,295	Do. do. Pref., £6 paid	10	6½ — 6¾	6½— 6¾	6⅝	...
37,548	London Platino-Brasilian Telegraph, Limited	10	4 — 6	4 — 6	...	...
100,000£	Do. do. do. 6 p. c. Debentures	100	105 —108	105 —108	...	...
49,900	*Metropolitan Electric Supply, Ltd., Nos. 6,101 to 50,000 (£10 paid)	10	7⅞ - 8¼	7⅞ - 8¼	8¼	7⅞
50,000£	Do. 5 p.c. debentures, 1 to 5,000 in bonds of £10, £20, £40	...	103 —106 xd	103 —106	104	...
15,000	Monte Video Telephone Co., Ord., Nos. 1 to 15,000 fully paid ...	5	½— 1½	½— 1½	...	...
28,000	Do. do. 6 p. c. Pref., Nos. 1 to 28,000 fully paid	5	2 — 3	2 — 3	...	...
484,597	National Telephone, Limited, Nos. 1. to 438,984	5	4⅜— 5	4⅜ — 5	5	4¹⅜
15,000	Do. 6 p. c. Cum., 1st Preference	10	14 — 15	14 — 15	...	...
15,000	Do. 6. p. c. Cum. 2nd Preference	10	13½ — 14½	13½ — 14½	...	...
119,234	Do. 5 p. c. Non-cum. 3rd Pref., Nos. 1 to 90,950 ...	5	5½— 5⅝	5½— 5⅝	5⅞	5⅝
726,477£	Do. 4½ p.c. Deb. Stock Prov. Certs. fully paid ...	...	113 —115	113 —115	114£	114
48,800	New Telephone, Limited, Nos. 25,901 to 74,700 ... (£2 paid)	10	... ...	... ...	...	...
6,452	Notting Hill Electric Lighting Company, Limited, fully paid ...	10	4½ — 5½	4½ — 5½	...	...
220,000	Oriental Telephone, Ltd., Nos. 80,001 to 300,000 (11s. only paid)	1	5/16— 5/16	⅛— ...	...	...
100,000£	Pacific and European Tel., Ltd., 4 p. c. Guar. Debs., Nos. 1 to 1,000	100	102 —105	102 —105	...	...
11,802	Reuter's Limited	8	5½— 6½	5½— 6½	...	...
19,980	St. James's & Pall Mall Electric Light Co., Ltd., Ord., 101—18,780	5	5⅞— 6½	5⅞— 6½	5¹⅞	5⅞
20,000	Do. do. 7 per cent. pref., Nos. 20,081 to 40,080	5	8 — 8½	8 — 8½	8	...
3,381	Submarine Cables Trust	Cert.	113 —118	113 —118	...	...
78,942	Swan United Electric Light, Limited ... ... (£3½ only paid)	5	2 — 2½	2 — 2½	...	...
37,350	Telegraph Construction and Maintenance, Limited	12	36 — 38	36 — 38	37½	36½
150,000£	Do do. do. 5 p. c. Bonds, red. 1894	100	104 —107	104 —107	...	...
58,000	United River Plate Telephone, Limited	5	2 — 2½	2 — 2½	...	...
146,370£	Do. do. 5 p. c. Debenture Stock ...	Stock	90 —100	90 —100	...	...
15,609	West African Telegraph, Limited, Nos. 7,501 to 23,109	10	5½— 6½	5½— 6½	...	...
260,900£	Do. do. do. 5 p. c. Debentures	100	98 —101	98 —101	...	...
30,000	West Coast of America Telegraph, Limited	10	2 — 3	2 — 3	...	...
150,000£	Do. do. do. 8 p. c. Debs., repayable 1902 ...	100	99 —103	99 —103	...	...
64,242	Western and Brazilian Telegraph, Limited	15	5½— 6½	6 — 6½	...	...
33,129	Do. do. do. 5 p. c. Cum. Preferred	7½	5½— 5⅝	5½— 5⅝	5½	...
33,129	Do. do. do. 5 p. c. Deferred	7½	1 — 1½	1½— 1⅝	1½	...
178,200£	Do. do. do. 6 p. c. Debentures "A," 1910 ...	100	103 —106	103 —106	...	...
222,700£	Do. 6 p. c. Mort. Debs., series "B" of '80, red. Feb., 1910	100	103 —106	103 —106	...	...
88,321	West India and Panama Telegraph, Limited	10	1 — 1½xd	1 — 1½	...	...
34,563	Do. do. do. 6 p. c. 1st Preference ...	10	9⅜— 10½xd	9⅜— 10½	...	...
4,669	Do. do do. 6 p. c. 2nd Preference ...	10	8½— 9½xd	8½— 9½	...	...
80,000£	Do. do. 5 per cent debentures (1917) No. 1 to 1,000	100	108 —111	108 —111	...	...
$1,214,000	Western Union of U.S. Tel., 7 p. c. 1st Mortgage (Building) Bonds	$1,000	113 —118	113 —118	...	...
169,000£	Do. do. 6 p. c. Sterling Bonds	100	102 —105	102 —105	...	...
59,900	*Westminster Electric Supply Corp., Ord., Nos. 101 to 42,953 ...	5	5 — 5½	5 — 5½	5⅝	5½

‡ Unless otherwise stated all shares are fully paid.

† Quotations on Liverpool Stock Exchange.

* Subject to Founders' Shares.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED:—Birmingham Electric Supply Company, Ordinary of £5 (fully paid) 5½—6½.—Brush Company, 4½ per cent. Debenture Stock, issued at 1 per cent. premium, 107—109.—Electric Construction Corporation 6 per cent. Debentures 87—92.—Electric and General Investment, shares of £5 (£1 paid), 1⅜—2⅜.—Founders' shares, 200—225.—Electricity Supply Corporation, Ordinary of £5, 5—5½.—House to House Company (£5 paid) 1—2.—Do. 7 per cent. Preference of £5, 4½—5½.—Do. 6 per cent. Debentures of £100, 97—102.—Kensington and Knightsbridge Electric Lighting Company, Limited, Ordinary Shares £5 (fully paid), 4⅞—5½, 1st Preference Cumulative 6 per cent., £5 (fully paid), 6¼—7.—Liverpool Electric Supply, £5 (fully paid) 6⅝—6¾.—Do. £3 10s. paid, 4⅞—4¾.—London Electric Supply Corporation. £5 Ordinary, ⅞—1⅛—Manchester Edison and Swan Company £9 (£1 paid), ⅛—¼.—Queen Anne's Mansions Lighting and Heating 6 per cent. £100 Debentures, 101—103.

Bank rate of discount, 3 per cent. (October 5th, 1893.)

BLACKENING OF INCANDESCENT LAMP BULBS.*

By W. STUART-SMITH.

In looking over the issues of an electrical journal for this year I have repeatedly noticed discussions as to the cause of blackening of incandescent lamp bulbs. The latest theory seems to come from France, and is to the effect that residual oxygen in the bulb, together with that which was occluded in the filament, attacks the carbon and forms carbonic oxide, which undergoes dissociation by coming in contact with the comparatively cold glass, depositing the carbon and leaving the oxygen free for a repetition of the process. It has been some years since I have paid attention to chemical matters, but, unless I am mistaken, cooling as above would *not* cause dissociation, and the above explanation cannot be the correct one. It seems to me that a portion of the action, at least, *must* be due to the following cause: It is well known that all substances in the solid or liquid form give off vapour, in fact, are surrounded by an atmosphere of their own vapour. If the substance is confined in an airtight space the vapour density is definite for every substance and for every temperature, but varies greatly with the temperature, being much greater for high temperatures.

For a given substance and a given temperature the vapour density will be the same no matter what other gases may be present, but if other gases are present in considerable quantities considerably more time will be required for the density to reach its maximum value. In a vacuum, on the contrary, the action is comparatively rapid.

Carbon when cold is a very stable substance and its vapour density very low, but at the high temperature of the white-hot filament vaporisation must be comparatively rapid and the vapour density relatively great. As the hot vapour comes in contact with the cooler glass it will deposit, and thus vaporisation, instead of stopping as would be the case if the glass was the same temperature as the filament, continues while the lamp is burning. When the lamp is extinguished the vapour in the globe must deposit on the glass until the definite density of the vapour of the cold carbon is attained. The more rapid blackening when the lamp is new may be due in part to the better condensing action of the clean glass, and it may be due in a greater part to the fact that some portions of the filament are more easily volatilised than others and the action consequently more rapid while these are being thrown off.

DEVELOPMENT IN ELECTRO-THERAPEUTICS.†

The recent meeting of the American Electro-Therapeutic Association in Chicago, brought together a large number of eminent medical practitioners of this country and Europe. The use of electricity has during the last few years rapidly extended to nearly every branch of medicine, and the programme of subjects presented to the congress was varied and comprehensive. Earnest and admirable work has been done in recent years in the utilisation of electricity by the medical practitioners of America, and of this a large share is credited to the labours of Dr. W. J. Morton, ex-president of the American Electro-Therapeutic Association and professor of nervous diseases at the New York Post-Graduate School and Hospital. In a recent interview, replying to the question, "What is the status of electro-therapeutics in this country to-day?" Dr. Morton said:—

"There has been a surprising change in the status of electro-therapeutics during the last two years. For this it seems difficult to give the exact reason. The medical profession seems to be peculiar in this sense, that an on-rush of ideas passes through it in periodical waves. Just now there is a strong desire in the profession to know more about electricity and its uses in medicine. But there are lacking central and teaching sources of information. There should be professorships in great colleges devoted to this subject, and there will be. Many indications are calculated to encourage the belief that we shall soon see great developments in the application of electricity in medicine. There is significance in the respect which the profession is now paying to electricity."

"Do you think much harm has been done in the retarding of this progress by the operations of electrical quacks?" he was asked.

"I don't think that the harm done to electro-therapeutics by quackery is anywhere near as great as the harm done by professional men themselves, who, without adequate knowledge, use a therapeutic agency which requires the highest order of knowledge. The quacks we can recognise; the physician ignorant of electricity is concealed by his title of M.D. The amount of scientific knowledge expected of a physician is entirely beyond the abilities of the average man to attain. Any one of the great departments of medicine might occupy the attention of a man of great ability for a lifetime, particularly such an one as electricity and its application to the cure of diseases. How, then, can you expect every hard-working practitioner of medicine to comprehend these difficult branches? If such a practitioner would admit this in regard to electricity, for instance, there would be no occasion for adverse comment."

"In what direction may the good results of this convention be looked for?"

"It is a trite answer, but none the less true, that the good results of this convention are likely to be purely educational, and will be confined mainly to professional men. Take a personal example: A physician comes to you and says with considerable vehemence that he has not the slightest faith in electricity in the cure of diseases. You talk to him, point out to him the objective evidence in favour of the action of electricity upon human tissue, its effect upon the pulse, upon the temperature and upon the secretion of carbonic acid, on the urea, and the diminution of uric acid, and show him a variety of cases treated in the clinic by electricity and without medicines, and his interest and astonishment grow apace. He will recognise, as many do who come to our New York Post-Graduate School, that in not using electricity in a long list of diseases, particularly chronic diseases, he has not been doing full justice to his profession and to his patients, and straightway he is most zealous to learn. In a broader sense, it is the object of this organisation to record in our *Transactions* and to spread abroad in the medical journals of the land the work of those best qualified to speak on this subject."

"What developments have there been in the therapeutic application of the high frequency, high potential currents with which Tesla has produced such sensational results in their physical application?"

"These currents have as yet not been applied in medicine, except in the form of static electricity. Tesla's work brought into a new light the older data which those who had used Franklinic electricity were familiar with, viz., the phenomena of the electrostatic field, in contradistinction to the electromagnetic, and the molecular strain into which it enables human tissue to be thrown. I have long been struck by the fact, and taught it, that in considering the effects of electricity in medicine we must take into account the current conveyed by the non-conductor as well as the current conveyed by the conductor. Thus far, we only hear of the human body as a conductor of electricity, just as a wire is, or a solution of salt. But the so-called non-conductors are conductive of a certain class of currents like the periodic, alternating currents of high potential. The non-conductors are, in electrical language, transparent or pervious to the currents of high tension. The dielectric or non-conducting molecules transmit the electric impulse as a current by convection, just as on a larger scale, a row of pith balls might conduct it. The older medical conduction of currents was by ampères accompanied by chemical decomposition; *i.e.*, it was electrolytic conduction. The new, or, at least, what I contend should be the new view to be taken, is that it should be by electromotive force mainly, very much in the same way as a fine jet of water might be employed under intense pressure instead of a larger jet at a lower pressure. Think, for instance, of the non-conducting or electrolytic particles of the human body as represented by so many tiny pith balls and treated by the high frequency high potential current. Every minute pith ball feels the

* New York *Electrical World*. † *Western Electrician*.

oscillating or alternating surge, is displaced, distorted, and thrown into a state of strain, is as quickly released from strain, and thus the entire mass undergoes a sort of molecular gymnastics, and in undergoing it nutritive changes which constitute health, or in their defective action disease, are influenced, to the extent that they demand more oxygen, more blood food, and thus excrete more water, carbonic acid and urea, and become healthier components of the organism. With the high frequency, high potential currents that it is possible to introduce into medicine, if we follow the indications of Tesla, but long since introduced into medicine by myself in static electricity by the aid of special oscillating currents of condensers, the entire human organism may be brought at any one moment under the influence of electrical energy. It is electrical energy for or against the chemical energies of the processes of life and disease, and it is the physician's business to see that the resultant takes a favourable direction. The high frequency, high potential currents have opened out an entirely new field of exploration in medicine, and one which is, to my mind, capable of infinite development."

"You anticipate wonderful practical results from new applications of high frequency currents. Has any use been made in this country of D'Arsonval's so-called sinusoidal current?"

"I have not heard of its use in this country. I have been experimenting with it for some time, and have had some remarkable results. This is a current which presents a true sine curve, *i.e.*, the strength of the current gradually rises to its full limits, and as gradually descends, to rise and fall again in successive waves. If each swell of this wave-like and sinuous movement of the current progresses in the same direction, we have chemical decomposition, but if each wave moves opposite to the other, then we have an alternating current, and there is no chemical decomposition. The peculiarity of a current of this description is that when the waves are very frequent per second, it does not produce muscular contraction, or pain, whereas, if the waves rose and fell abruptly, as in common induction coils, muscular contraction and great pain might be produced. In other words the more frequent the waves or "periods" the less effect there is on the muscle and nerve. But it must not be supposed that such a current, cut up into frequent waves and called high frequency, high potential current, is not doing any work because the muscles do not contract. Incandescent lamps inserted in the circuit are found to glow with great brilliancy, and if the human body be tested by other means than by mere muscular contraction, it is found that wonderful effects are being produced. The tissue is living faster, is burning up more rapidly, is absorbing oxygen from the blood with a capacity increased by nearly 50 per cent., and the worn out products from the combustion of the tissues are being thrown off with corresponding rapidity. In other words, under the electric influence thus established, the human being is living faster, burning up faster, and, at the same time, repairing damages at an equal rate. Now, as life is motion, this is exactly what the tissues want and need, and they show corresponding improvement in their health, and disease shows corresponding indisposition to maintain its hold upon them."

"In what class of diseases is this current likely to be specially beneficial?"

"There is a vast class of chronic diseases to which this reasoning applies, like rheumatism, gout, obesity, neurasthenia or nervous exhaustion, diabetes, and the degeneration of the nerves in certain nervous diseases. The effects of the low frequency sinusoidal current are pointed out by D'Arsonval. The special physiological effect of the high frequency, high potential current, in that it does not produce muscular contractions or pain, and which was published and placed on record by myself ten years ago, was observed with a remarkable simultaneousness by Tesla, Elihu Thomson, and D'Arsonval in 1891. When Tesla and D'Arsonval had reached their highest frequencies, it was found that the mechanism to produce them was discovered by myself ten years earlier, namely, condensers and discharging rods with an air-gap in a primary circuit, influencing a secondary which gave the high frequency, high potential current, exhibiting the peculiar effects alluded to."

"From what class of currents do you consider the greatest benefit is likely to be derived in the future of medicine?"

"It is from currents of high frequency and high potential, like those alluded to above, that I think the greatest good is to be expected. They are currents which will produce results of great benefit in the human system, considered either as an ordinary conductor or as a transparent conductor, namely, a dielectric conductor. They are so expansive and diffusive in their effects as to include the entire organism rather than a local part; but, except so far as appertains to static electricity, these currents are yet unknown in medicine. You see, therefore, that we have a future before us in electro-therapeutics if we only pause and gaze at this single phase of the general subject. How numerous the other phases are it would more than weary you if I attempted to dilate on."

AN INTERESTING INSTALLATION.

PROJECTS for the transmission of energy over a considerable distance are overshadowed by the great Niagara scheme, and are apt to be unnoticed. Mr. Rafael M. de Arozarena prepared a paper for the late congress at the World's Fair, giving an account of a most interesting transmission scheme in Mexico. We cull the following facts from the paper, which has been recently published.

Among the industrial enterprises taken up in Mexico by local capital, the plant for the supply of the electric light and power in the City of Guadalajara, Jalisco, is one of the most notable, not merely because of its magnitude with respect to the investment required, but also because the project necessitated the use of novel and special machinery, the source of supply being located 17 miles from the base of demand.

The problem was to instal at the falls of Juanacatlán (the Niagara of Mexico) a hydraulic and electric plant which should be capable of supplying in the City of Guadalajara—distant 17 miles—sufficient electric energy to operate some 950 H.P. in the form of light, divided up as follows:—7,500 incandescent lights of 16-candle-power each, and 200 arc lights of 2,000 candle-power each.

After careful consideration and study, the plans were projected and machinery ordered from the following well-known houses:—The electric machinery and material from the Thomson-Houston International Electric Company, of Boston, Mass; the turbines and piping from James Leffel & Co., of Springfield, O.

The falls of Juanacatlán are on the Grande River, and situated some 17 miles (28 km.) south-east from the City of Guadalajara. The whole volume of the river falls at this point some 58 feet in a perpendicular line, with the shores above the falls sloping gently to the stream. Below the falls, the shores on both sides slope almost at an angle of 45°, leaving but little room at the bottom upon which a building could be erected, for which reason the building was projected of three stories, as shown in the illustration.

The work above the falls was simple and of easy execution, for, the river being very wide at this point its depth is small, and a masonry wall some 3 feet high was built, running across the river for two-thirds of its width and at an angle of 45° to the line of the falls, the object of which was to carry the greater part of the water in the river to a given point on its left bank directly at the falls; then a raceway was formed 14 feet high by 14 feet wide, from which the 7 feet diameter conduit pipe carried the water down to the turbines. This conduit pipe is made of wrought-iron sheets ¼ inch diameter, riveted together, no flanges being used. At the head of the pipe is located a vent pipe, to protect the pipe from collapsing when the wooden gate which is located at its entrance is closed. The pipe, to conform to the nature of the fall at this point, has two elbows of 90° and one of 45°, from which on a horizontal line it connects the three turbines together, reducing its diameter from 7 to 6 feet between the first and second turbine, and from 6 to 5 feet between the second and third turbines. Directly in line with the piping are located the three horizontal double Leffel turbines, and between the turbines and the conduit pipe in the connecting pipes, which are 4 feet 6 inches diameter each, are located Ludlow straightway gate valves, which are opened and shut by geared hand wheels, thereby permitting the water to be closed off from each or any of the turbines without having to stop the others.

The turbines located on the first floor of the building are horizontal double wheels, placed in one case; both wheels are connected directly on to the same shaft, which extends out from the case on both sides, and has at each end a sheave pulley for transmitting the power. Each turbine is 20 inches diameter, and has its independent draft tube; and as the river is known to rise in the rainy season from 1 to 2 m., the turbines were placed 16 feet above the bed of the river, with draft tubes, all 10 feet long, discharging into a well 4 feet deep (which is the average depth of the river in the dry season), making the distance from the centre of the turbines to the surface of constant water in the tailrace exactly 12 feet.

The power of each set of turbines is 550 H.P., making a total of 1,650 H.P. The power is transmitted from the turbines to a countershaft placed in the second floor of the building. A rope driver is used, of endless manilla, plumbago, tallow-laid rope, 1 inch diameter, using an idler pulley on a stress car, with weight. Each pulley has 15 grooves to receive the 15 strands of rope.

The 42-inch diameter pulleys on the turbines connect with clutch pulleys on the countershaft of 84 inches diameter, giving a speed of 6,594 feet per minute to the rope. This driver, when the speed does

not exceed 7,500 feet per minute, by using sheaves at least 40 times the diameter of the rope, the writer has found to be very satisfactory, and, on account of its duration, much cheaper than belt drivers, especially for damp places.

For furnishing current to operate the arc lights, the familiar Thomson-Houston "M.D." dynamos were employed. They have capacity each for 50 arc lights of 2,000 candle-power, or, in other words, a rated output of 25 kilowatts. The current strength is 10 ampères and consequently the maximum voltage 2,500.

The dynamos weigh 3 tons each, require floor space of about 15 square feet, a belt speed of 3,863 feet per minute, with a consumption of nearly 50 H.P. under full load. Four such dynamos are in use, operated two in "series" to avoid multiplicity of wire. Thus, for a total capacity of 200 lights, only two circuits leave the generating station.

The current is conveyed from the dynamos by means of highly insulated copper wires to a slate switchboard arranged for any desired combination of machines; from here through current indicators to the lightning arresters, from which the wires are led to the pole line. The pressure utilised being rather above the safe limit, the insulation of the circuit is augmented by fastening the wires upon oil insulators, mounted upon wooden cross arms. The construction of these insulators is such that leakage is practically prevented, as, in order to escape by leakage, it would be necessary for the electricity not only to overcome the wire insulation, but also to pass through two strata of oil, the insulating qualities of which are well known.

In the city of Guadalajara these circuits are led to a central distributing station, in which is placed a duplicate plant of lightning arresters, switchboards, and testing instruments. It is from this station that the lights are directly controlled.

Standard double carbon arc lamps are used throughout the city. They are suspended from steel cables stretched from corner to corner, supported by house structures arranged with pulleys and cables so that the renewal of carbons may be readily attended to.

As but one dynamo was desired for this installation, one of special construction was supplied. It is of the alternating current type, has 40 pole pieces, and yields approximately 350 ampères at 1,000 volts, or, say, 350 kilowatts.

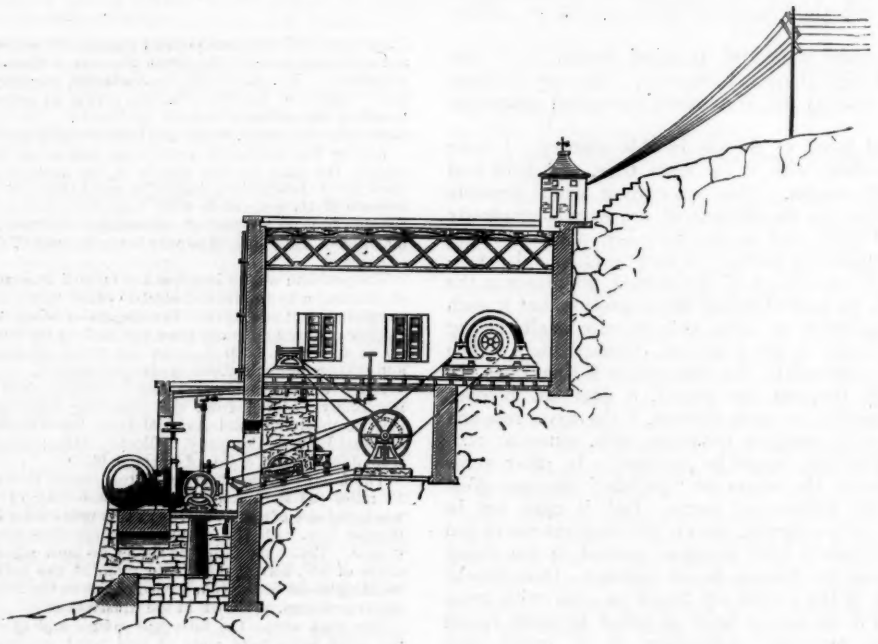
The dynamo weighs between 30 and 40 tons, requires a floor space of 216 square feet, and a belt speed of 5,024 feet per minute, consuming under full load some 750 H.P. The armature is run at the low speed of but 300 revolutions per minute, and the shaft, which is 9 inches in diameter, is furnished with a 60-inch diameter pulley, having 28 grooves for 1¼-inch rope, as this dynamo is driven from the countershaft with a rope driver the same as between the turbines and the countershaft. The 40 pole pieces forming the field magnets are excited by means of a separate exciter, known as "D-5," and having an output of 5 kilowatts at 125 volts.

To increase the voltage from 1,000 to 5,000, a bank of 10 step-up transformers was installed. These are built upon the lines of the type "F" oil transformer, manufactured by the General Electric Company. They transform, it is stated, the energy of the dynamo at an efficiency of about 98 per cent. The transformers are insulated with oil, and are banked or operated in multiple. They have a capacity of 30 kilowatts each, weigh approximately 1,300 lbs., each requiring 12 cubic feet of space. They are protected by a simple but effective system of circuit breakers and fuse connections, and the current passing from them is carried through a special lightning arrester designed to protect circuits of extraordinary high potential.

The cross arms, pins, and insulators used in connection with the alternating circuit are precisely the same as those described under the heading "Arc Circuits."

The high potential incandescent line carried to the central station in the city of Guadalajara is passed through lightning arresters and safety devices, as described above, to the bank of step-down transformers, which reduces the pressure to 1,000 volts, at which potential it is carried through the streets of Guadalajara as in ordinary installations. In the Guadalajara central station switchboards are installed, enabling any combination of lights and circuits to be made, without attention to the dynamos at the point of generation. The number of lights in operation, the physical conditions of the circuits, and indeed the conditions of the dynamos at the generating station, can all be determined in Guadalajara. Telephonic communication is established between the two stations, enabling those in charge to give their directions promptly.

As a further protection against lightning, which in the State of Jalisco is very severe, iron poles have been used, each surmounted by a pointed lightning arrester rising some 3 feet above the top of the pole, or, say, 5 feet from the highest current-conveying wire. These arresters are, of course, mechanically connected to the iron poles, besides which they are joined to each other by means of an iron wire.



THE INSTALLATION OF THE GREAT AND LITTLE BOLTON CO-OPERATIVE SOCIETY.

CONSIDERABLE extensions are now being made to the electric light installation of the Great and Little Bolton Co-operative Society at their establishments in Bridge Street and Bark Street, by the Manchester Edison-Swan Company, Limited. The installation is a very fine one, consisting of over 1,000 incandescence lamps of 16 C.P. each, with all the generating plant, and has been entirely laid down by the Manchester Edison-Swan Company in their very best style and workmanship.

The plant comprises an Edison-Hopkinson dynamo, driven by a non-condensing engine, and a steam turbo-dynamo, the whole of which was laid down in 1889, and replaced an old Elphinstone and Vincent dynamo plant.

The Edison-Hopkinson dynamo, made by Messrs. Mather & Platt, is a shunt machine with an output of 500 ampères at 105 volts. It is driven by a 14-inch double belt at a speed of 430 revolutions per minute.

The lamps are wired on six circuits, controlled from a slate base switchboard by sliding contact switches and Cunyngham's automatic cut-outs. There is also provided an ammeter and one of Cardew's engine-house voltmeters.

The largest circuit from this machine supplies 250 16-C.P. lamps in the millinery and drapery departments, and the lending library, which are situated at a distance of 400 yards from the dynamo room. The cables consist of two pairs of 19/14s copper, and run overhead, suspended from strong iron wires. The loss of volts in transmission is found to be about 8 per cent. The latest addition to the plant is a smaller Edison-Hopkinson machine, which gives 450 ampères at 105 volts when run at a speed of 550 revolutions per minute. It is a compound machine, and is intended to work a more variable load than the larger dynamo. The new department for the wholesale and retail clothing manufacture is supplied from this machine, and is solely dependent on the electric light, no gas whatever being laid on in the rooms.

Both these machines are driven from a countershaft, and the power

is developed by a horizontal single cylinder non-condensing engine of 130 I.H.P., made by Messrs. Jackson Brothers, Wharf Foundry, Bolton. It runs at 72 revolutions per minute, with a steam pressure of 80 lbs. per square inch. The power is transmitted to the countershaft by a 16-inch two-ply leather belt from the fly-wheel, which is 16 feet in diameter. The speed of the engine is regulated by one of Schaffer & Budenberg's centrifugal governors, with spiral adjustment spring, which can be adjusted while the engine is running, varying the speed from 68 to 92 revolutions per minute. The engine is also fitted with expansive cut-off valves, and is throughout of the best design and finish.

The steam turbo-dynamo is by Clark-Chapman, and Messrs. C. A. Parsons & Co., Newcastle-on-Tyne. It will give 120 ampères at 105 volts when running at a speed of 10,000 revolutions per minute. The diameter of the armature is 4 inches, and that of its shaft 1 inch. The speed of the turbine, as is well known, is regulated by a magnetic governor controlled by the magnetic field of the dynamo, in conjunction with an air fan and throttle valve arrangement.

Careful note is taken of the hours run by the engine and dynamos, the stores used and repairs executed, and the engineer, Mr. Diggle, made some deductions to show the relative cost of the electric light and gas for the quarter ending December 15th, 1891, which may be of interest.

There were, however, only some 766 16-C.P. lamps burning then, and all run from the large dynamo, but now the engine is more heavily loaded, the consumption of steam per unit will probably be less, and consequently the comparison will be more favourable for the electric light, without taking into consideration the reduced cost of incandescence lamps.

The item for wages is the part time of the attendant spent on the installation, the remainder of his time being occupied with other work.

The consumption of gas to give the same illuminating power as a 16 C.P. lamp was ascertained by actual tests made during the period for which the accounts are given.

Cost of electric lighting, September 18th to December 15th, 1890, number of lamps 766, number of hours lighted 295½ :—

COST OF PLANT.

	£	s.	d.
Turbo dynamo	219	7	6
Voltmeter	5	5	0
Dynamo	461	14	0
„ gear	43	0	0
766 lamps and cable	1,100	0	0
Engine house	517	16	0
Boiler	320	3	0
Surveying	8	16	9
Steam pump	17	0	0
Engine, &c.	450	0	0
Belting	76	8	0
	£3,219	10	3

	£	s.	d.
Interest, 5 per cent., and depreciation, 10 per cent. on cost of plant	121	0	0
Fuel, 61 tons, 10 cwts., at 9s. 1d. per ton, less 2½ per cent.	27	4	6
Water, 89,000 gallons at 6d. per 1,000 gallons	2	4	6
Oil, 12 gallons at 2s. 6d. per gallon	1	10	0
Packing	0	12	0
Cleaning waste, 28 lbs. at 28s. per cwt... ...	0	7	0
Wages	7	14	0
Renewals	9	7	6
Contingencies	10	0	0
	£179	19	6

Each lamp equals gas burner consuming 7½ cubic feet of gas per hour.

Cost of 766 burners burning 295½ hours equals 1,691,775 cubic feet, which at 2s. 8d. per 1,000 feet equals £225 19s. 4d.

NEW PATENTS—1893.

22,698. "Detector galvanometers." W. ROUTLEDGE. Dated November 27th.

22,723. "Improvements in telephonic transmitters." G. A. NUSSBAUM. Dated November 27th.

22,765. "Multiple telegraphy." J. MCCRAITH. Dated November 28th. (*Complete.*)

22,773. "Improvements in reflectors for gas and other lights." F. MOORE and F. ARCHER. Dated November 28th.

22,817. "Improvements in electric meters." H. ARON. Dated November 28th.

22,822. "An improved motor for assisting the propulsion of cycles and other vehicles, applicable also for driving dynamos and other machinery where power is required." T. J. WHITEMAN and W. FLETCHER. Dated November 28th.

22,856. "Improvements in printing telegraphs." R. A. FOWDEN. Dated November 28th.

22,858. "Improvements in electric lighting and extinguishing apparatus for gas burners." E. ORLING. Dated November 28th, (*Complete.*)

22,863. "Improvements in and relating to dynamo-electric machines." H. H. LAKE. (Communicated by the Thomson-Houston International Electric Company, United States.) Dated November 28th. (*Complete.*)

22,876. "Automatic switches." J. HOPKINSON. Dated November 29th.

22,885. "Improvements in and connected with electric generators and motors." M. T. PICKSTONE. Dated November 29th.

22,912. "Improvements in electrodes and cells for secondary batteries or accumulators." E. H. WHEELER. Dated November 29th.

22,956. "New improved electro-positive galvanic battery electrodes." C. A. J. H. SCHROEDER and H. E. R. SCHROEDER. Dated November 29th. (*Complete.*)

22,957. "Improvements in arc lamps." J. H. WHEAT and A. WHEAT. Dated November 29th.

22,959. "Improvements in or relating to apparatus for controlling transformers used in feeding electric current circuits." H. W. WILKINSON. Dated November 29th.

22,960. "Improvements in or relating to the method and means employed for controlling electrical devices from a distance." H. W. WILKINSON and L. PENSON. Dated November 29th.

23,017. "An improved arc lamp." H. R. LOW and F. R. BROWN. Dated November 30th. (*Complete.*)

23,022. "Improvements in or relating to junction service boxes for electric conductors." G. H. NISBETT and J. B. ATHERTON. Dated November 30th.

23,074. "Improvements in electrical switches." W. P. THEBMANN. Dated December 1st.

23,083. "Improvements in apparatus for recording electric currents." H. ARON. Dated December 1st.

23,088. "An improved electrical indicating target." G. H. HODGES and J. W. I. HILLIARD. Dated December 1st.

23,116. "Improvements in electrical apparatus for indicating or indicating and registering variations in temperature or pressure or both." L. SUNDERLAND. Dated December 1st.

23,121. "Improvements in incandescence electric lamps." J. Y. JOHNSON. (Communicated by C. H. Stearn, Switzerland.) Dated December 1st.

23,133. "Improvements in electrical cranes or travellers." H. J. COLES. Dated December 2nd.

23,170. "Improvements in electrical transformers." L. B. MILLER and M. W. WOODS. Dated December 2nd.

23,182. "Electric station indicator for railway waiting-rooms." A. JEENEL. Dated December 2nd.

23,198. "New method of transmission over long cables." S. ROOS, E. RIGHETTI, and G. O'CONNELL. Dated December 2nd. (*Complete.*)

23,211. "Improvements in electro-mechanical governors, and in the means of operating the same." W. T. GOOLDEN and J. S. LEWIS. Dated December 2nd.

23,219. "Improvements in watch compasses (non-magnetic)." W. HUDSON. (Communicated by S. Watkins, Turkey.) Dated December 2nd. (*Complete.*)

23,221. "Improvements in sockets or receptacles and regulators for incandescent electric lamps." H. H. LAKE. (Communicated by C. A. Hussey and C. C. Edey, United States.) Dated December 2nd.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1892.

10,451. "An automatic switch for electric current transformers." R. N. LUCAS, A. J. MAYNE, and A. G. NEW. Dated June 1st. Relates to an arrangement such that whenever the secondary circuit is made, the primary transformer coil is switched on, and when the secondary circuit is broken the said primary coil is switched off (*i.e.*, thrown out of connection with the mains). 5 claims.

12,087. "Improvements in electric heating devices and contacts for the same." F. W. SCHINDLER-TENNY. Dated June 29th. Has for its object the construction of improved means for the level adjustment of electric heaters, for preventing their covers from warping, and for protecting the heating body from moisture, and also of contact devices to be used for these apparatus. 5 claims.

13,146. "Improvements in microphones." Sir C. S. FORBES. Dated July 18th. Consists in a microphone controlled by an electromagnet. 6 claims.

13,338. "An improved switchboard." Sir C. S. FORBES. Dated July 21st. Is designed more particularly for short lines and for domestic hotel or factory use, but is also applicable to small exchange systems. 3 claims.

13,375. "Improvements in or relating to electric meters, recording apparatus, and controlling gear." W. L. SPENCE. Dated July 21st. Consists in the application to electric measuring, recording and controlling purposes of the well known star wheel and tappet or wiper gear which is usually put on paper making machines for the purpose of keeping the web straight. 3 claims.

13,395. "Improvements in or relating to electrical apparatus for signalling." M. MERCIER. Dated July 22nd. Consists of a combination of one or more flexible air or watertight envelopes, diaphragms,

cones, or bags, preferably made of India-rubber or other watertight material, which entirely covers the contacts, and a packed gland or glands, suitably arranged, through which is passed a convenient length of single, twin, or multiple cable connected to the contacts inside the key and arranged so that the cable or wire of each contact is a part of the whole cable and insulated from the other cables. 3 claims.

13,542. "An improvement in tanks or cells for electrolysis and like purposes." F. E. ELMORE and A. S. ELMORE. Dated July 25th. Claim:—A tank or cell for electrolysis and like purposes consisting of an inner and an outer box of wood with a space between them filled with plastic bituminous composition, substantially as described.

13,543. "Improvements in electrical installations for producing alternating currents." SIEMENS BROS. & Co., LTD. (Communicated from abroad by Messrs. Siemens and Halske, of Berlin.) Dated July 25th. Relates to a system of parallel arranged alternate current generating machines, which has the advantage that all the machines belonging to the system have exactly the same number of alternations, and consequently, when they are to be connected in parallel, they do not require first to be brought to synchronous motion, and, in addition, they cannot get out of step. 2 claims.

13,678. "A combined electric bell push and pull." W. R. WEBB. Dated July 27. Relates to an arrangement whereby an electric circuit can be closed for operating a bell either by pressing a push knob or button, or by pulling a cord or its equivalent. 2 claims.

13,718. "Improvements in conduits for electric mains and in laying the same." H. L. DOULTON and C. E. MORRIS. Dated July 27th. The inventors lay electric mains in stoneware or earthenware casings similar to pipes but with multiple ducts. They make the joints between the lengths of this casing by surrounding the ends with a divided collar, which may be of the same material as the casing. Portland or other cement is employed to render the joint watertight, and to prevent the cement penetrating between the ends of the lengths of casing they are lapped round with adhesive waterproofed canvas. The ends of the casing, and also the collar, are provided with annular grooves where they come together to render the joint more secure. 3 claims.

13,765. "Improvements in alternate current electro-dynamic machines." M. HUTIN and M. LEBLANC. Dated July 28th. Has for its object to render comparatively easy the attainment of synchronism in alternate current machines, and to insure the continuation of such condition, no matter what disturbing causes may occur. 4 claims.

13,894. "Improvements in submarine cables." W. H. PREECE. Relates to the cables described in the number of the REVIEW for July 21st.

14,064. "A continuous direct electric current machine and motor." W. ALDRED. Dated August 4th. Consists of a number of tee-shaped pieces of iron mounted on a central iron plate in the case of a disc armature, or on the shaft in the case of a barrel armature. 4 claims.

14,567. "Improvement in grooved wood cases for electric cables or wires." S. HINDLEY. Dated August 12th. Consists of a series of strips of thin wood, papier mache, brass, steel (or other like substance) about quarter of an inch shorter than the width of the cases, been screwed or nailed on the centre rib of the case, so that they can be turned round (the cases having been countersunk across the grooves for the reception of the strips) at a distance of six or sixty inches apart (as may be required) in a parallel line with the grooves. 4 claims.

15,057. "Improvements in electric arc lamps." J. BROCKIE. Dated August 20th. Relates to a construction and arrangement of brake or clutch to control the movement of the carbons in electric arc lamps, so as to give an effective control and keep in adjustment for a considerable time; also relates to a device for retaining the weight of the carbon holders, &c., upon the regulating lever when the carbons are consumed. 1 claim.

15,066. "Improvements in electrical cut-outs for high tension currents." C. E. WEBBER and G. H. NISBETT. Dated August 20th. The inventors arrange the fuse with as long a path as may be required, and so dispose and confine it that when fusion occurs any resulting arc will be correspondingly elongated, and shall follow the path of the fuse, as being that of least resistance, and at the same time shall be unable to take the shortest lineal course or path, which shall be that of greater or greatest resistance. 2 claims.

16,154. "A new or improved inking apparatus for telegraphic purposes. J. F. MILLS. Dated September 9th. Is constructed so as to regulate the supply or distribution of the ink over the surface of the felt roller pad, by the means of the insertion of a tube, into which a brush is placed to paint the wheel or roller pad with ink. Either the tube or brush can be instantly removed for cleaning or renewal purposes, the arm of the stop cock of the lubricator is so arranged as to connected with the lever of the starting and stopping gear of the clock-work of the instrument, thus:—the ink will flow into the tube or distributor to the felt wheel or pad when the ink is evenly distributed. The ink flows when the instrument is set in motion, but ceases to flow when the instrument is at rest. 4 claims.

16,570. "An improved method and apparatus for electrical propulsion of vehicles." F. E. ELMORE. Dated September 16th. Claims:—1. The described method of electrically propelling a vehicle by magnetising two pairs of toothed bars by the passage over them of two bobbins supplied with electrical currents in quadrature, inducing from these bars currents in the coils of propelling bobbins in closed circuit with each other, and thus exciting alternately the propelling bobbins, causing them to be attracted and repelled by the teeth of the bars over which they pass, and thus to give propulsion to the vehicle on which all the bobbins are carried. 2. For electrical propulsion of a vehicle in the manner above referred to, in combination with two pairs of stationary toothed iron bars a vehicle carrying a pair or several pairs of magnetising bobbins, and a pair or several pairs of propelling bobbins, arranged and operating substantially as described.

16,866. "Improvements in electrode-plates for secondary batteries." A. MULLER. Dated September 21st. Claim:—An electrode-plate for secondary batteries having ribs divided into sections by grooves which are so arranged as to alternate in the alternating ribs, substantially as described.

16,892. "Process and apparatus for the extraction, separation and refining of metals by electrolysis." D. TOMMASI. (Under International Convention.) Dated April 1st. Relates to a process and apparatus for the extraction, separation, and refining of metals by electrolysis, and it has for its object to reduce the cost of the operation:—1. By preventing the polarisation of the cathodes by making them in the form of discs of carbon, either alone or mixed, with oxide of copper, and causing them to revolve so that their acting surfaces are alternately immersed in the bath and exposed to the air, and by subjecting said surfaces to the continuous friction of brushes for the purpose of freeing them from all adhering matters. 2. By reducing to a minimum the electrical resistance of the electrolyte by bringing the electrodes closer together. 3. (*a*) By separating, in the case of a binary metallic compound, the two metals simultaneously, the first by electrolysis and the second by chemical precipitation by immersing in the bath, bars or ingots of the first metal which precipitates the second, and which is itself attacked by the bath so that the liquor holds in solution only the salt of this first metal, which metal goes to increase the electrolytic deposit and is thus recovered, so to speak, without loss; (*b*) by separating, in the case of a ternary metallic compound, the three metals at one time by means of a bath in which two only of the metals are soluble, one being electrolysed and the other precipitated, while the third remains unattacked. 4. By keeping the electrolyte homogeneous by the agitation due to the revolving motion of the discs and of the bars or ingots above mentioned. 6 claims.

16,893. "Process and apparatus for the extraction, separation and refining of metals by electrolysis." D. TOMMASI. (Under International Convention.) Dated May 21st. The object of the present improvement is to provide an arrangement of cathode disc adapted for use in cases where it is desired to obtain the metallic deposit in a compact form. 2 claims.

17,160. "Improvements in telephone switchboard apparatus." J. E. KINGSBURY. (A communication from abroad by the Western Electric Company, of Chicago.) Dated September 26th. Relates specifically to the construction of the annunciator and to the apparatus of multiple switchboards. 16 claims.

17,246. "Improvements in or connected with electric primary batteries." T. J. D. RAWLINS. Dated September 27th. According to this invention the carbon or negative electrode is made disc shaped, and supported upon an axle arranged to be revolved, so that a part of the electrode is always out of the exciting fluid while it is being revolved. 2 claims.

17,287. "A new or improved shield or cover for electric gas lighting apparatus." J. HAMER. Dated September 28th. Consists in forming a shield or cover of a suitable shape and size to cover and surround the electric instrument. This cover is capable of being slided up and down suitable rods or other guides attached to or forming part of a bracket or pedestal attached to a wall or other suitable place. 1 claim.

17,462. "Improvements in and apparatus for moulding earthenware electric switches, ceiling roses, bell pushes, and the like, and forming screw threads thereon." J. MEIR. Dated September 30th. The inventor first of all forms blanks or blocks of the desired article, moulded in plaster moulds or "jollied" approximately to the size required and semi-dried. The blanks or blocks are then introduced into a fly press fitted with specially formed dies for pressing the article to its final form and forming the screw thread thereon. 4 claims.

17,504. "Improved electric switch." D. LOCH. Dated October 1st. The switch is mounted on a slab, or back of wood, or other non-conducting material (preferably provided with a cover) which may be placed in any convenient position, and the switch bar is caused to move between two stop pins, or studs, both to open and close the circuit by the pull of a cord. 5 claims.

17,691. "Apparatus for the cutting of glass by electricity." L. HAVAUX. Dated October 4th. Claims:—1. The process of cutting articles of glass by electricity, consisting in placing the article to be cut, such as a tumbler, within an almost complete circular metal ring or strip (of a slightly greater diameter than that of the article), the strip being brought to incandescence by means of a strong electric current, substantially as described. 2. A device for cutting glass by electricity, consisting of an almost complete circular ring of German silver or other bad-conducting metal, firmly secured between two insulating and fire-proof rings, and capable of being adjusted to the desired level, while remaining in communication with the poles of a source of electricity, the current passing through the circular plate, heating to incandescence the edge thereof which projects beyond the inside of the fire-proof rings, while the article to be cut is placed and turned round in the interior thereof, substantially as described.

18,160. "Improvements in telephonic receivers." J. P. ANNETT. Dated October 11th. The inventor applies an enlarged cup or orifice of suitable shape, made of wood, vulcanite, or other material, having the edge of such cup or enlargement fitted with a suitable rubber or other flexible lip or rim, so that when the instrument is placed to the receiver's ear, external sounds are largely excluded. 1 claim.